The New England
Journal of Medicine

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Volume 230 May 25, 1944 Number 21

THE SURGICAL TREATMENT OF ESOPHAGEAL ATRESIA AND TRACHEOESOPHAGEAL FISTULAS*

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ATRESIA of the esophagus with or without tracheoesophageal fistula has been a baffling problem for the surgeon. If there is any surgeon who has attempted to save the lives of patients suffering from these malformations who has not had many disappointments and numerous trials and tribulations, I have not heard of him. Until very recent years this condition was considered incompatible with life. Obstetrician and pediatrician alike commonly advised that it was not worth while to attempt any remedial procedure. In the last few years, however, a few successes or partial successes have been reported from various parts of the country, and a correct point of view has been adopted: namely, that surgical intervention should be attempted. We have had a comparatively large experience with these cases at the Children's Hospital in Boston, and it may be of interest to relate our experiences in the surgical management of these anomalies.

In 1884, Mackenzie[1] attributed the first description of this condition to Durston (1670), and in 1821 Martin[2] published the first case report. In 1919 Plass[3] reported 136 cases from the literature. In 1931 Rosenthal[4] reported 255 cases, in 1933 O'Hare[5] reported 281 cases, and by 1941 Ashley[6] was able to collect 314 cases. From the records of the Children's Hospital in Boston can be added 72 cases, which brings the total close to 400. These figures make it apparent that atresia of the esophagus is a much more frequent anomaly than it has usually been considered to be.

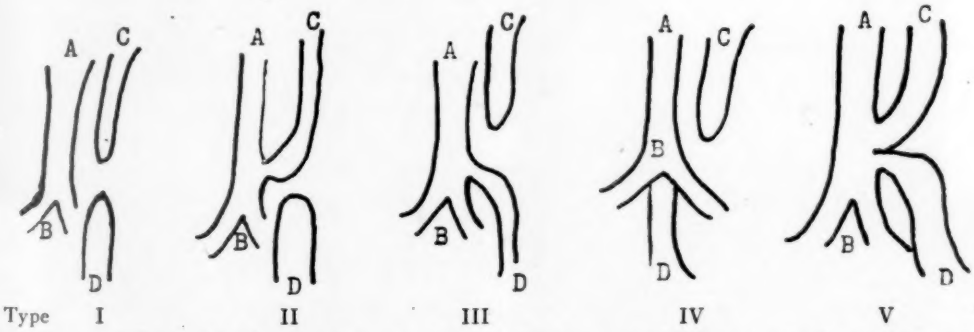

FIGURE 1. *Diagram Showing the Arrangement of the Trachea and Esophagus in the Various Types of Esophageal Atresia and Tracheoesophageal Fistula.*

The letters refer to the following structures: A — *trachea;* B — *bifurcation of trachea;* C — *upper segment of esophagus; and* D — *lower segment of esophagus.*

There are to be found in the literature various classifications of congenital anomalies of the esophagus. For the purposes of the present discussion, only those will be considered that have been seen in this series from the Children's Hospital. These cases may be divided into five types, as illustrated in Figure 1. Each type has minor variations. In Type I, the upper portion of the esophagus ends in a blind pouch in the region of the body of the first or second dorsal vertebra, and the lower segment of the esophagus begins again in a blind pouch at the level of the fourth or fifth dorsal vertebra. In Type II, the upper segment of the esophagus ends in a fistulous tract entering the trachea just above its bifurcation, whereas the lower segment is much the same as in Type I. In Type III, the upper segment ends blindly as in Type I, whereas the lower segment is connected to the trachea just above its bifurcation by a fistulous tract. This type and Type IV are by far the commonest in the reports

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The Rachford Memorial Lecture, presented before the Cincinnati Academy of Medicine, January 19, 1944.

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of the literature as well as in our own experience. Type IV is similar to Type III except that the fistulous tract of the lower segment enters the trachea at its carina instead of just above its bifurcation. In Type V, both the upper and lower segments communicate with the trachea, as shown in the diagram. These types may be quite accurately diagnosed and are important to consider when one is deciding on his plan of treatment. For any form of treatment to be successful, it is of paramount importance to make the diagnosis as early as possible and to have the infant transferred to a hospital equipped to care for this kind of patient. This early diagnosis and allocation of the patient is usually the responsibility of the obstetrician or pediatrician.

The diagnosis may be suspected when the newborn infant has an excess of saliva in the mouth and perhaps an associated cyanosis. The next suggestive symptom to present itself is immediate vomiting after the first and any succeeding feeding. If the infant is not put to the breast or is not offered the bottle, he may appear quite normal after the excess saliva has been suctioned from the pharynx. Examination of the chest, however, usually discloses moist rales caused by aspiration of saliva or fluid given. These rales are apt to be most marked at the right apex, possibly for the reason that in the dorsal position aspirated fluid enters the right main bronchus and then the bronchus to the right upper lobe more easily than any other part of the lungs. Abdominal examination shows the abdomen to be either distended with air and tympanitic or completely flat without tympany, according to the variety of the malformation.

Obviously, in Types I and II there is no possibility for air to enter the stomach and intestines, so that one finds the abdomen sunken and without tympany. In Types III, IV and V, however, every time the infant breathes he forces air into the stomach and intestines. In these types, therefore, the abdomen is moderately distended and extremely tympanitic and sometimes contains large amounts of air if the tracheoesophageal fistula of the lower end of the esophagus is a large one.

With these symptoms and findings, the next step in the investigation is to insert a small rubber catheter in the esophagus. If this meets obstruction at 10 to 12 cm. from the lip margin, the diagnosis of esophageal atresia is practically confirmed. It is well, however, to check this finding by a roentgenologic examination to make sure that the catheter has not curled up in the pharynx or esophagus. The administration of barium is undesirable regardless of the type of malformation. If the case is of Type II or V with a fistula between the upper segment and the trachea, the administered barium goes directly into the lung and causes an aspiration pneumonia or an increase in the already existing one. The only reason for which a contrast medium is desirable is to determine the presence or absence of a tracheal fistula in the upper segment of the esophagus. To gather these data, a small amount of lipiodol should be used during a fluoroscopic inspection. If a large amount is used and it is not watched with the aid of the fluoroscope, some of it may spill over the top, so

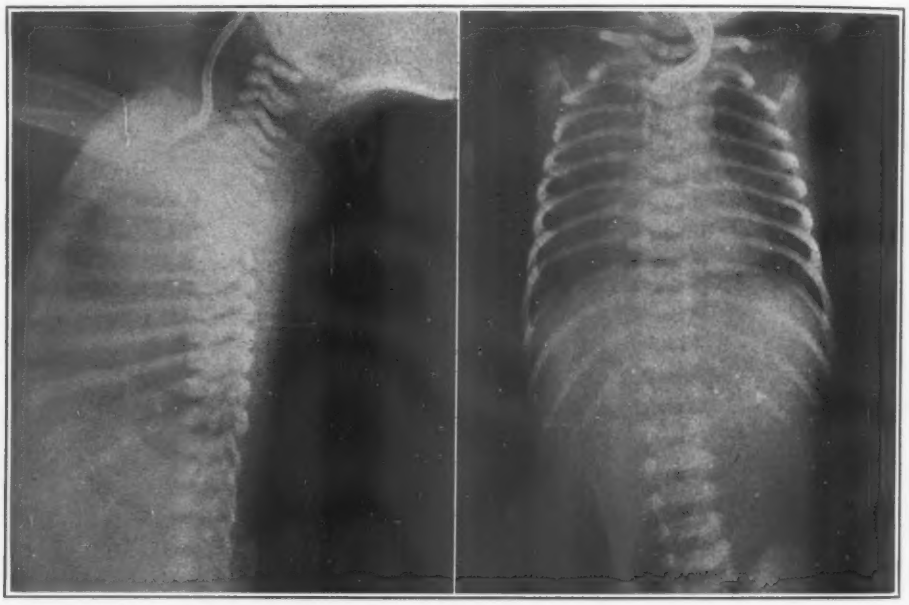

FIGURE 2. *Atresia of the Esophagus, Type I.*
These roentgenograms were taken preoperatively. Note the complete absence of air in the stomach and intestine.

to speak, be aspirated and confuse the picture. A roentgenologic examination of the abdomen is also of advantage in differentiating the varieties of the malformation. If this examination shows no air in the abdominal viscera, one must be dealing with Type I or II; if, on the other hand, the ex-

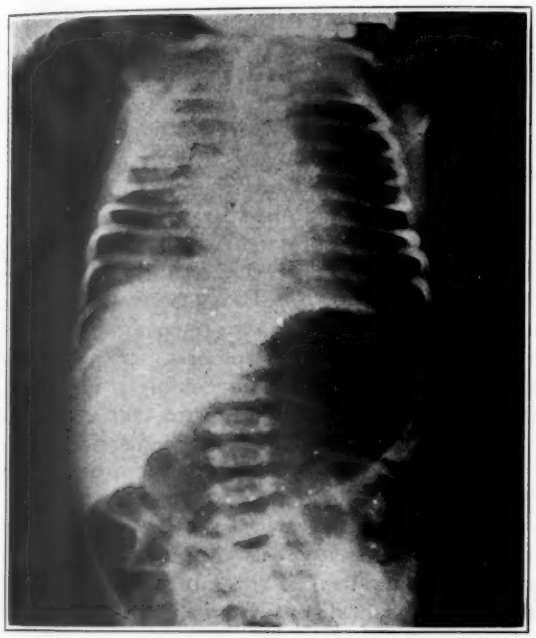

FIGURE 3. *Atresia of the Esophagus, Type III.*
Note the catheter in the blind end of the upper segment, the pneumonia at the right apex and the barium (unwisely given) scattered through the lung. There is marked distention of th stomach and intestine.

amination shows the stomach and intestines filled with air, one can rest assured that one is dealing with Type III, IV or V. The careful records kept by Dr. Sidney Farber in the Pathology Department have made it possible to collect data that are not only of interest but of value in helping to formulate the plan of treatment.

From post-mortem findings it is apparent that these anomalies of the esophagus are frequently associated with anomalies of other parts of the body, as demonstrated by Table 1, which shows the type

TABLE 1. *Anomalies Associated with Atresia of the Esophagus.*

TYPE	NO. OF CASES
Atresia or stenosis of the small intestine	3
Meckel's diverticulum	8
Malrotation	3
Imperforate anus	7
Fistulas of the rectum	3
Anomalies of the heart and aorta	10
Ureteral stenosis	6
Atresia of the ureter or kidney	5
Miscellaneous	18

and number of other malformations that occurred in this series. It should be noted from a glance at this table that many of these anomalies are of a serious nature and that some are even incompatible with life without relief by major surgical procedures.

TABLE 2. *Site of Fistula in Cases of Types III and IV.*

SITE OF FISTULA	NO. OF CASES
At carina	16
Above carina:	
0.0–0.5 cm.	9
1.6–1.0 cm.	5
1.1–1.5 cm.	4
1.6–2.0 cm.	2
Over 2.6 cm.	1

It can also be stated, however, that there were 23 cases in this series with no accompanying malformations.

There is a considerable variation of the location of the fistulous opening into the trachea, as seen in Table 2, which lists the cases of Types III and IV.

TABLE 3. *Distance between Esophageal Segments.*

DISTANCE	NO. OF CASES
Ends overlapping	1
0.0 to 0.5 cm.	5
0.6 to 1.0 cm.	7
1.1 to 1.5 cm.	6
2.6 to 3.0 cm.	4
3.1 to 3.5 cm.	2
8.0 cm.	1

Table 3 shows the variation of the distance between the two segments of the esophagus as noted in the post-mortem findings. This variation be-

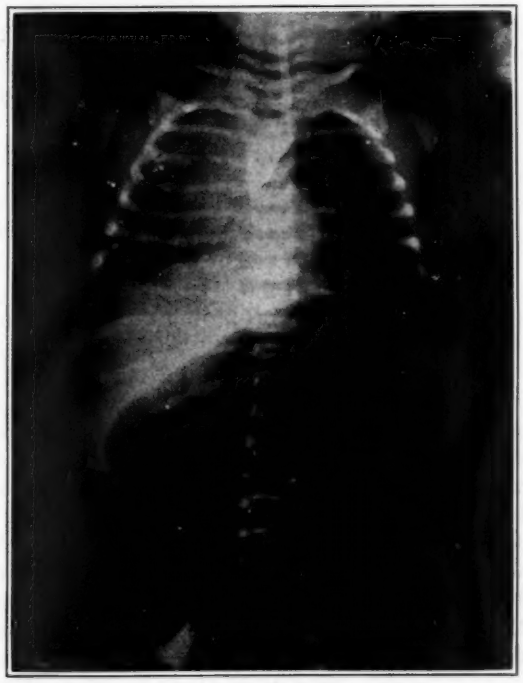

FIGURE 4. *Atresia of the Esophagus, Type IV.*
Note the catheter in the blind end of the upper esophageal pouch, the pneumonia on the right and the marked distention of the stomach and intestine.

comes an important factor when one is considering the selection of the type of operation best suited for a given case.

These variations are not so important, however, as the two fundamental causes of death, which are pneumonia and starvation. Of these two, pneumonia is the more difficult to combat. Any operation that fails to prevent aspiration of saliva or fluid given either by mouth or by stomach is usually doomed to failure.

There have been numerous plans of surgical approach to this problem, some of which come close to meeting the requirements for combating these two main causes of death. The operation devised by Gage and Ochsner,[7] which consists of tying off the cardia and doing a gastrostomy and marsupialization of the upper segment of the esophagus, has much to recommend it. It prevents the constant aspiration of secretion from the upper segment and allows feeding by gastrostomy without danger of reflux into the lungs through the tracheoesophageal fistula. Carter's[8] objections to the operation are that it leaves a long esophageal pouch connected to the trachea and that the esophagostomy opening is too far removed from the gastrostomy. The first objection appears to be valid, since this pouch is certain to be a source of aspiration or infection at some later period. Our experience leads us not to concur with the second objection, since we have found that liquid and food pass through a long skin tube quite as readily as through a short one. We do, however, have another objection to the operation of Gage and Ochsner. This is that the ligature around the cardia may slough through and result in either leakage or recanalization of the esophagus. This catastrophe has indeed happened in 2 of our cases under a slightly different condition: namely, when the esophagus has been tied higher up in the mediastinum. To obviate leaving a long lower-segment pouch of the esophagus, Gamble[9] devised an operation that has the obvious drawback of a permanent tracheal fistula. He tied off the cardiac end of the stomach and brought the esophageal end of the stomach connecting with the esophagus out onto the abdominal wall. Leven[10] in 1936 advocated an operation embodying much the same principles as did that of Gage and Ochsner but with a different technic. He later abandoned this plan, which he had used with 2 patients, both of whom died of pneumonia.

Carter[5] devised an operation that consisted of bringing the lower end of the esophagus down through the diaphragm and leading it up onto the abdominal wall. This was done through an abdominal approach. We have the same reason for objecting to Carter's operation that he himself uses against the operation of Gage and Oschner: namely, the leaving of a long lower-segment pouch of the esophagus. It should also be noted that his patient died of pneumonia after eight to nine weeks of life. Regardless of his report that the pneumonia was an incidental development independent of the remaining esophageal pouch, it is still impossible to believe that the presence of such a sac is desirable or without danger.

The next operative procedure to be considered is that of a direct attack on the site of the malformation through the back extrapleurally, tying off the tracheal esophageal fistula and marsupializing the ends of the lower and upper segments in the back. This plan was originally advocated by our former associate, Dr. Charles G. Mixter, and it was performed on several occasions by various members of the surgical staff of the Children's Hospital. One patient who was operated on according to a modification of this plan by my associate, Dr. Thomas H. Lanman,[11] survived for forty-seven days but eventually succumbed to pneumonia, pleuritis, mediastinitis and septicemia. This operative plan has some advantages; it leaves no blind esophageal pouch, takes care of salivary secretions and provides for feeding, and leaves open the possibility of a later end-to-end anastomosis. It has the disadvantages that the esophagostomy is in a position in which it is hard to handle and that it is difficult to prevent the development of mediastinitis, which has ultimately been a factor in the death of every patient in whom we have employed it. We have abandoned its use.

End-to-end anastomosis through an extrapleural approach in the back is without question the operation of choice in all patients in whom the two ends of the esophagus are close together. It closes the tracheoesophageal fistula, takes care of the salivary secretions, provides for feeding and theoretically restores the esophagus nearer to normal than does any other plan. The technical difficulties are three: the discrepancy in size of the two esophageal segments, the distance between the segments and the anatomic structure of the esophagus itself. The first two of these obstacles are variable according to the findings in each case. The third one is constant but should be surmountable provided that the other two factors present only minor difficulties. Until recently attempts by various members of the Children's Hospital staff at direct end-to-end anastomosis in cases of tracheoesophageal atresia have met with no success. Through a modification of our technic in suturing, the patients in 2 cases of direct anastomosis are doing well. The esophagus is reached by the same extrapleural approach that we have been using for the last four or five years for tying off the tracheoesophageal fistula. An L-shaped incision is made between the inner border of the scapula and the spine on the right side and run underneath the inferior angle of the scapula (Fig. 5). By this incision the third, fourth and fifth ribs are exposed in the back. A section of the fourth rib is excised subperiosteally, and the third and fifth ribs are cut to allow for retraction. The pleura is then stripped off the thoracic cage until the azygos vein is seen. One next identifies the communicating branch of the azygos vein, and it is tied and cut.

This acts, as a rule, as an excellent landmark for the esophagus. Both segments of the esophagus are then identified. The tracheocsophageal fistula of the lower segment is tied and cut. After the tracheoesophageal fistula has been eliminated and the lower segment of the esophagus has been mobilized, the upper end of the esophagus is likewise identified and mobilized, care being taken not to injure the pneumogastric nerve. Four stay sutures are placed near the end of each segment, as shown in Figure 6. Each of these sutures starts about 1.5 cm. from the end of the segments of the esophagus. These four sutures are of great importance since they give a firm attachment to tissue, which is by nature a loose structure and allows ordinary sutures to pull out easily. The catheter, which has already been inserted in the upper segment of the esophagus, is run through the lower segment into the stomach and left there. One next uses four or five interrupted sutures to approximate the mucous membrane of each end of the esophagus. The four stay sutures are tied, and four interrupted mattress sutures are placed between them to invert the edges. The anastomosis thus having been completed, the ends of the ribs that have been cut are approximated. The periosteum of the rib that has been excised, is likewise sutured together, and the muscle layers of the back are reunited and the skin closed over a small drain that has been left in between the pleura and the thoracic cage. During the whole procedure the pleura has not been opened and there is no problem of pneumothorax. This approach is preferable to that on the left side, which has been advocated by Haight and Towsley,[12] but whether one reaches the esophagus through the right or the left side at the back is a matter of preference and is of no great importance.

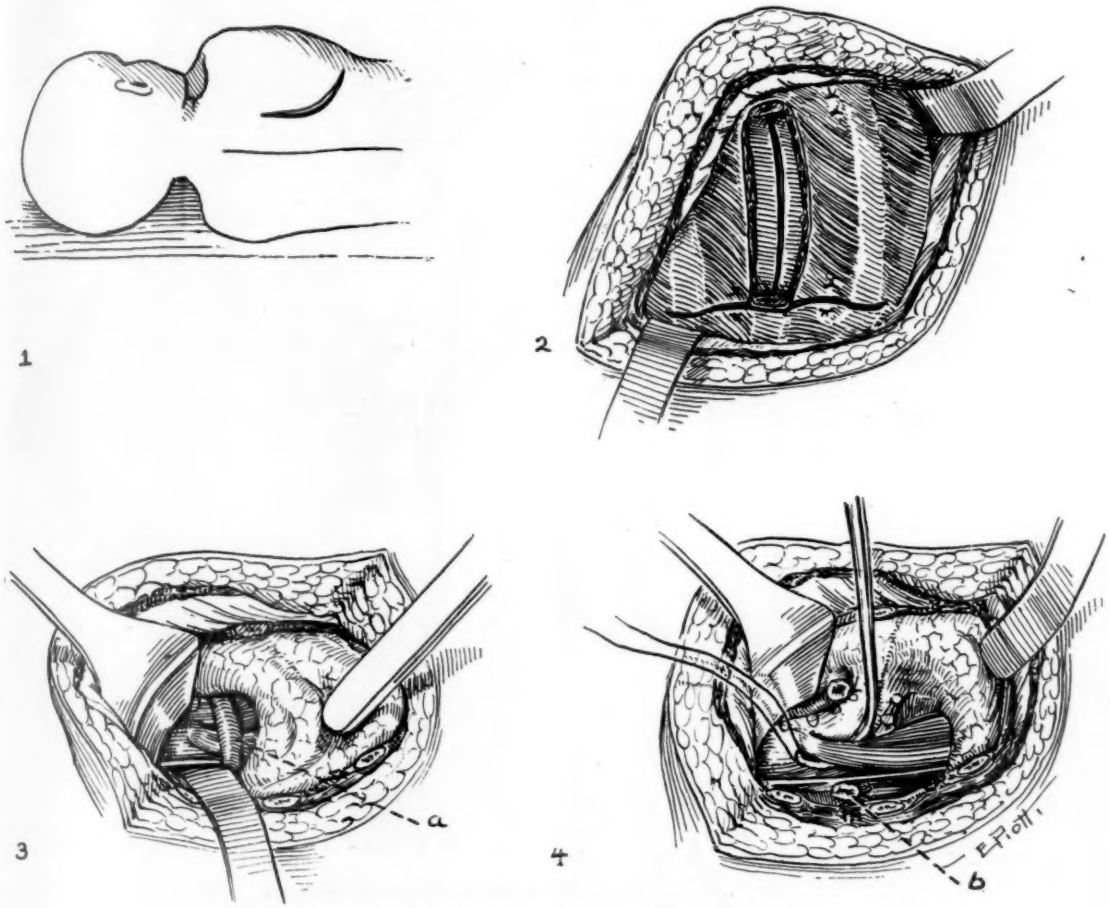

FIGURE 5. *Operation for Direct Anastomosis of Esophagus.*
1 *shows the incision between the inner border of the scapula and the spine;* 2 *shows the third, fourth and fifth ribs exposed with a section of the fourth rib excised subperiosteally;* 3 *shows the pleura and lung retracted and the communicating branch of the azygos vein* (a) *lying over the esophagus; and* 4 *shows the communicating branch of the azygos vein* (b) *cut, and the esophagus and tracheo esophageal fistula exposed and ready for tying and cutting.*

The patient is fed through the inlying catheter for a week or ten days, when a gastrostomy is performed and the esophageal catheter is removed. In the 2 surviving patients treated by this technic we have avoided the difficulties of a leak in the anastomosis, which was experienced by Haight in his successful case. Although this is the operation of choice in

selected patients in whom the two ends of the esophagus are close together, it is an extremely difficult operation and is probably unsafe in patients in whom the two ends of the esophagus are far apart.

As previously stated, it was apparent in our experience that pneumonia was the usual factor that prevented survival. It was also presumed that aspiration was the major cause of the pneumonia.

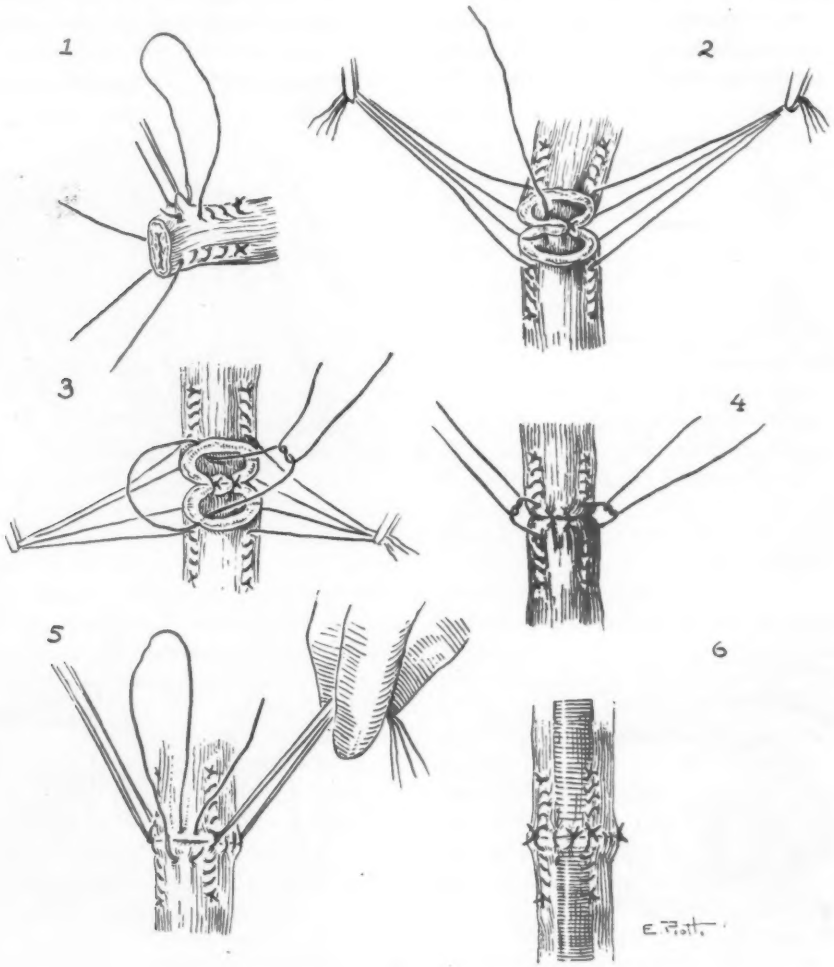

FIGURE 6. *Operation for Direct Anastomosis of Esophagus.*

1 shows the placement of the stay sutures; 2 and 3 show the two ends of the esophagus brought together by the stay sutures, and the placement of the interrupted sutures to the mucous-membrane sutures; 4 shows the completion of the mucous-membrane sutures, and the stay sutures being tied; 5 shows the method of placing the mattress sutures for the sake of inversion after the other sutures have been tied; and 6 shows the completed anastomosis with the inlying catheter running through it.

For these cases we have adopted a different technic, which we have been following for a little more than four years, with 8 patients now living.

It is interesting to note that Leven,[13] at almost the identical time, came to the same conclusion about methods of attacking this problem and adopted principles identical with ours with only minor variations of technic. So far as I know, he has the oldest living patient with esophageal atresia and a tracheoesophageal fistula, his patient being twenty-four hours older than our oldest living one. In a recent personal communication he states that he has 4 additional patients living who have been operated on according to principles similar to those about to be described.

It therefore seemed logical to adopt a surgical plan that would have for its first objective the elimination of the conditions favoring aspiration. After this had been accomplished, the next step was to provide for feeding, and the third step was the construction of an anterior thoracic esophagus.

In patients with Types III and IV in whom the ends of the esophagus are too far apart to warrant an attempt at direct anastomosis, the esophagus again is approached in the same manner as just described for a direct anastomosis and the point of the tracheoesophageal fistula is identified. The fistula is then tied and cut. In some earlier cases only the tracheoesophageal fistula was tied, and in 2 cases the ties cut through the esophagus, the

esophagus was recanalized and the fistula was re-established (Fig. 7). One of these patients died from drowning after a gastrostomy feeding. In the other case it was recognized by the symptoms

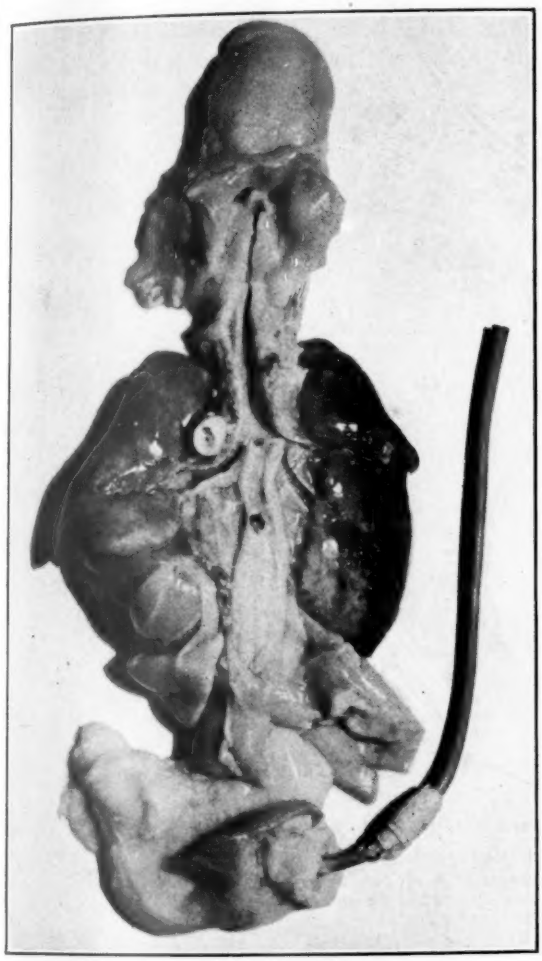

FIGURE 7. *Post-Mortem Specimen Showing a Recanalized Esophagus.*
The tie that was originally around the esophagus is within its lumen.

that the patient was in the same condition. The wound was reopened, the fistulous tract was cut and the ends were tied off. The patient is in the process of having his anterior thoracic esophagus constructed.

After the tracheoesophageal fistula has been obliterated by tying and cutting, the chest wound is closed as before. In a few days a gastrostomy is done, which allows feeding to be carried on successfully without the danger of the milk's being regurgitated into the lung. During this interval the patient is kept in a moderate Trendelenburg position and either continuous or intermittent suction is applied to the pharynx to prevent the aspiration of saliva.

The third stage of the operation consists of bringing the upper segment of the esophagus out in the neck. This is accomplished by making a small transverse incision 1.5 cm. above and parallel to the clavicle, the inner end of the incision starting at the midline and the incision being carried laterally to the left for a distance of 3.5 cm. With the head extended and rotated to the right, the trachea is displaced laterally and does not interfere with the identification or freeing of the esophagus. In some cases, to give more room, the lower end of the sternocleidomastoid muscle is cut. There is usually a fibrous band extending downward from the lower end of the upper segment of the esophagus into the mediastinum. This must be cut in the mediastinum before the blind end can be delivered. After its delivery it is opened, the musculature of the esophagus is stitched to the subcutaneous tissue and the mucous membrane is approximated to the skin. The esophagostomy allows for the free discharge of saliva over the neck and avoids the danger of aspiration pneumonia.

After these procedures have been completed one can wait for an indefinite period before constructing the anterior thoracic esophagus. In our first successful case, considerable time was spent in trying to connect the esophagostomy to the gastrostomy by

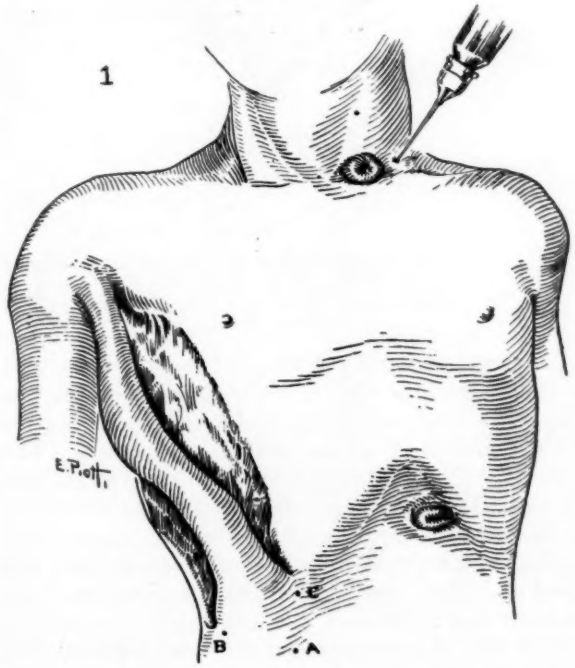

FIGURE 8. *Fifth Step of the Operation in Types III and IV.*
1 shows the tube graft with the Thiersch graft underneath it, and the marking of the skin around the esophagostomy for the transfer of the lower end of the tube graft (A, B *and* C).

various devices. Although this has been successfully done in adults, it was eventually abandoned as being impractical in infants.

The original gastrostomy in our oldest patient was changed to the Ssabanejew–Frank type and connected to the skin tube of the anterior thoracic

esophagus. In the next patient, now over two years old, the original gastrostomy, which was of the Witzel method has consisted of making two parallel incisions, elevating the flaps of skin and suturing the

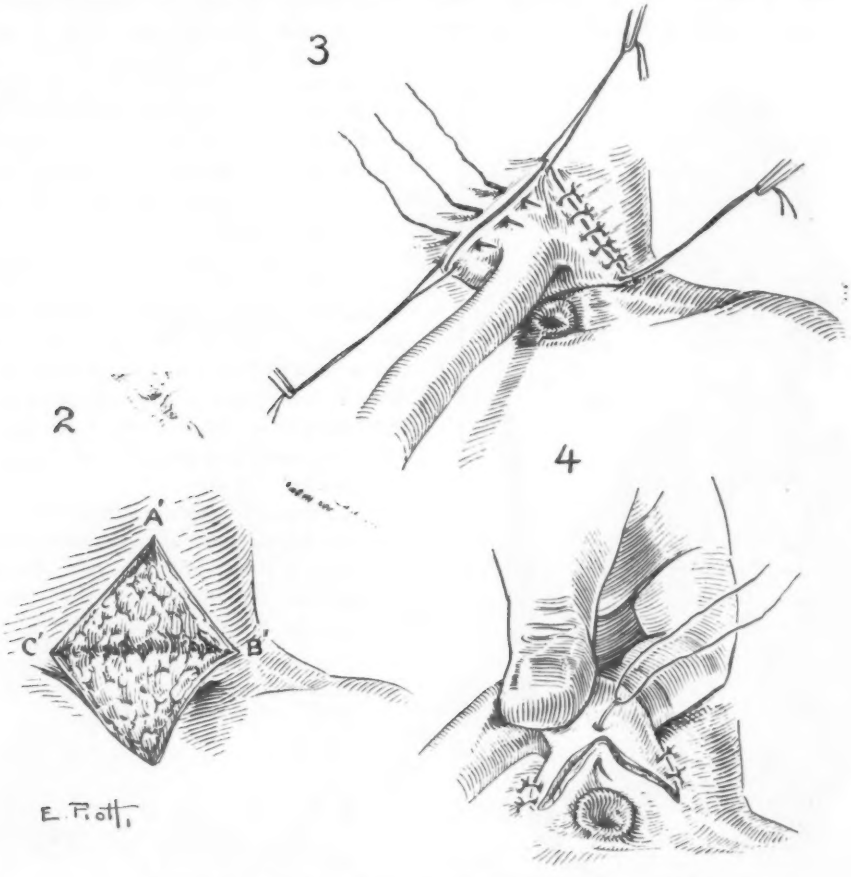

FIGURE 9. *Fifth Step of the Operation for Types III and IV.*

A V-shaped incision (A', B', *and* C') *is made over the esophagostomy opening as shown in* 2. *The points* A, B, *and* C, marked in Figure 8, *are then sutured to* A', B', *and* C', *respectively. The flap that is turned down over the esophagostomy opening is sutured to the undersurface of the tube graft.*

type, was closed and the whole of the lower segment of the esophagus was brought down through the diaphragm and out of the abdominal incision onto the chest wall. This was done in two stages. The first stage consisted of the freeing of the esophagus by an extrapleural approach through the right side of the back. The second stage was a laparotomy, during which the cardiac end of the stomach was freed and the lower segment of the esophagus was brought down through the esophageal hiatus and out of the abdominal incision. This segment was next tunneled under the skin of the chest, brought out through a suitable-sized incision and stitched to its skin edges. This procedure is much like that recommended by Carter[8] except that no segment of the esophagus is left in the mediastinum. Although we have a patient still living who was operated on two years ago by this plan, its use has been abandoned on account of the difficulty of regurgitation.

The next problem is the construction of the skin tube and the establishment of the continuity of the esophagus with the stomach. This has been done in several ways by different surgeons. The simplest

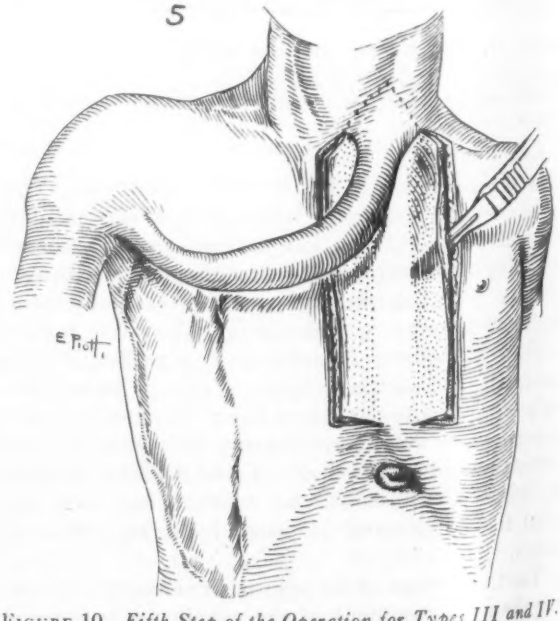

FIGURE 10. *Fifth Step of the Operation for Types III and IV.*

5 *shows the incision for making the epithelial-lined tube.*

edges together with the skin inside. The raw surface is then covered by undermining the skin on either side of the skin tube and bringing these flaps over the skin tube. The objection to this plan is the requirement of tension sutures, which are undesirable, and the fact that the newly constructed skin esophagus must necessarily be compressed, making it difficult for food to pass through it. To obviate these disadvantages, other surgeons have covered

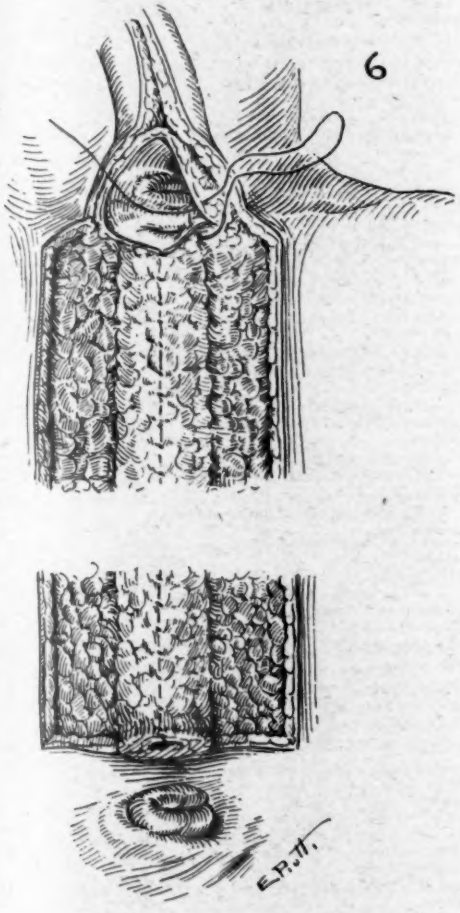

FIGURE 11. *Fifth Step of the Operation for Types III and IV. 6 shows the construction of the epithelial-lined tube, which is to be covered by the tube graft, as shown in Figure* 12.

the raw surface of the skin tube with a free graft. Although this has proved satisfactory in adults, it has the disadvantage in infants of requiring pressure while the graft is taking, and it also leaves a thin-walled tube, which is subject to leakage or injury. To avoid these objections, the following plan was adopted. First, a tube graft of appropriate length is raised on the right side of the chest, starting in the right axilla and running down onto the abdominal wall in front of the iliac crest. The raw surface under this tube is covered by a Thiersch graft to avoid pulling over the skin of the chest wall (Fig. 8). Some three weeks later the lower end of this tube graft is freed and sutured to the skin of the neck over the esophageal opening, as shown in Figure 9. After this tube graft has acquired its

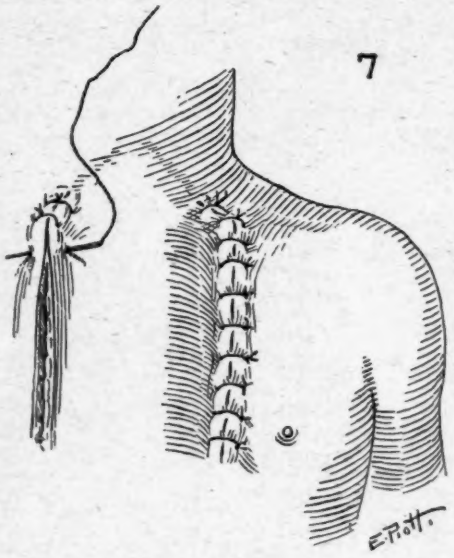

FIGURE 12. *Fifth Step of the Operation for Types III and IV. 7 shows the tube graft being placed over the epithelial-lined tube and being sutured in place.*

new circulation from the neck, the epithelial-lined tube that is to act as an esophagus is constructed and covered by the tube graft, as shown in Figures

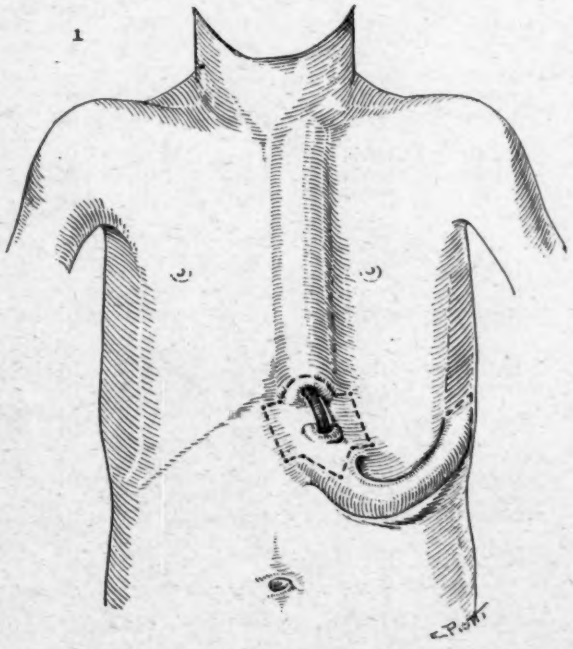

FIGURE 13. *Final Step of the Operation for Types III and IV. 1 shows the second tube graft, which is to be used for the covering of the lower part of the epithelial-lined tube.*

10, 11, and 12. These procedures leave an epithelial-lined tube with a good skin covering carried to within a few centimeters of the gastrostomy opening (Fig. 13).

The next step is similar to what was carried out to make the upper portion of the skin tube. A tomy opening. An inverted skin tube is constructed to include the gastrostomy opening and to connect

TABLE 4. *Cases of Esophageal Atresia with or without Tracheoesophageal Fistula Operated on at the Children's Hospital, 1940–1944.*

HOSP. NUMBER	DATE OF ADMISSION	AGE AT ADMISSION	SEX	TYPE	OPERATION	OPERATOR	DURATION OF LIFE
240342	11/28/39 3/15/40	1 day 4 mo.	F	III	Gastrostomy Ligation of tracheoesophageal fistula Exteriorization of cervical esophagus Anterior thoracic esophagus	Dr. Ladd	Living (4 3/12 yr.)
249209	2/ 4/41	3 days	M	III	Ligation of tracheoesophageal fistula Gastrostomy	Dr. Gross	6 days
249410	2/10/41	2 days	M	III	Ligation of tracheoesophageal fistula	Dr. Ladd	3 days
251743	5/ 7/41	18 hr.	M	III	Ligation of tracheoesophageal fistula	Dr. Lanman	2 days
256430	10/13/41	2 days	M	IV	Primary anastomosis to esophagus Gastrostomy	Dr. Gross	30 days
257773	12/ 2/41	5 days	F	I	Gastrostomy Marsupialization of esophagus	Dr. Ladd	36 days
257275	12/15/41	2 days	M	I	Gastrostomy Marsupialization of esophagus	Dr. Ladd	Living (2 3/12 yr.)
257185	12/18/41	1 day	F	IV	Ligation of tracheoesophageal fistula Gastrostomy Marsupialization of esophagus	Dr. Ladd	6 days
258624	12/30/41	1 day	M	IV	Ligation of tracheoesophageal fistula Gastrostomy	Dr. Ladd	5 days
258658	1/ 9/42	2 days	F	IV	Ligation of tracheoesophageal fistula	Dr. Gross	3 days
259379	3/ 1/42	8 days	M	III	Ligation of tracheoesophageal fistula	Dr. Gross	11 days
261528	5/16/42	2 days	F	V	Ligation of tracheoesophageal fistula Gastrostomy	Dr. Ladd	8 days
265092	9/8/42	3 days	M	III	Ligation of tracheoesophageal fistula Gastrostomy and marsupialization of esophagus	Dr. Ladd	35 days
266051	9/27/42	2 days	M	III	Ligation of tracheoesophageal fistula Gastrostomy and marsupialization of esophagus	Dr. Ladd	106 days
267150	10/16/42	1 day	F	III	Anastomosis of esophagus and ligation of tracheoesophageal fistula	Dr. Gross	1 day
267162	10/19/42	4 days	M	III	Ligation of tracheoesophageal fistula Gastrostomy and marsupialization of esophagus Secondary ligation of tracheoesophageal fistula Anterior thoracic esophagus	Dr. Ladd	Living (17 mo.)
268156	11/25/42	5 days	M	IV	Ligation of tracheoesophageal fistula Gastrostomy and marsupialization of esophagus	Dr. Ladd	147 days
268827	12/15/42	4 days	M	III	Ligation of tracheoesophageal fistula	Dr. Ladd	7 days
268997	2/14/43	4 days	F	III	Ligation of tracheoesophageal fistula	Dr. Gross	6 days
271085	3/30/43	3 days	M	III	Ligation of tracheoesophageal fistula with direct anastomosis	Dr. Ladd	6 days
272514	4/29/43	4 days	M	III	Ligation of tracheoesophageal fistula	Dr. Ladd	6 days
274245	7/14/43	7 days	M	III	Marsupialization of esophagus	Dr. Ladd	10 days
275005	7/20/43	3 days	F	III	Ligation of tracheoesophageal fistula Partial excision of duplication of stomach and gastrostomy Marsupialization of esophagus	Dr. Ladd	10 days
275631	8/10/43	6 days	F	III	Ligation of tracheoesophageal fistula with primary end-to-end anastomosis Gastrostomy	Dr. Ladd	Living (7¼ mo.)
275095	8/23/43	4 days	F	III	Ligation of tracheoesophageal fistula Gastrostomy Marsupialization of esophagus	Dr. Ladd	Living (7 mo.)
276726	9/18/43	3 days	M	III	Ligation of tracheoesophageal fistula	Dr. Ladd	8 days
277394	9/22/43	15 days	M	III	Ligation of tracheoesophageal fistula with primary esophageal anastomosis	Dr. Gross	17 days
277277	9/27/43	4 days	M	III	Ligation of tracheoesophageal fistula Gastrostomy Marsupialization of esophagus	Dr. Ladd	Living (6 mo.)
276847	10/ 7/43	6 days	F	III	Esophageal anastomosis with ligation of tracheoesophageal fistula	Dr. Ladd	9 days
276848	10/ 8/43	5 days	M	III	Ligation of tracheoesophageal fistula Gastrostomy	Dr. Ladd	Living (5½ mo.)
278319	10/23/43	10 days	M	III	Primary anastomosis of esophagus with ligation of tracheoesophageal fistula Gastrostomy	Dr. Gross	Living (5 mo.)
278540	11/20/43	2 days	M	IV	Ligation of tracheoesophageal fistula Gastrostomy Marsupialization of esophagus	Dr. Ladd	Living (3¾ mo.)
279539	12/30/43	3 days	F	IV	Ligation of tracheoesophageal fistula Marsupialization of esophagus	Dr. Ladd	Living (2½ mo.)
280539	2/ 9/44	2 days	F	I	Mediastinal exploration Gastrostomy Marsupialization of esphagus	Dr. Ladd	Living (1¼ mo.)

small tube graft is raised in the left flank with its end transferred to a position just below the gastros- with the upper skin tube, as shown in Figure 14. The tube graft is used to cover the raw surface, as

was previously done above. Figure 15 shows the anterior thoracic esophagus completed in the oldest patient, who is now over four years of age.

Since 1939 we have operated on 34 patients according to our present method (Table 4). Of these patients, 6 have had primary anastomosis of the esophagus and 2 are living. Twenty-eight patients have had the three-stage operation consisting of obliteration of the esophageal fistula and gastrostomy and esophagostomy; 9 of these patients are living.

A few examples of the causes of death in the patients not living are of interest. The cause of one death appeared to be the usual pneumonia, the effects of the operation and, as a contributing factor, an open intraventricular septum and other cardiac anomalies. This was a Type IV anomaly. A second patient, who also had a Type IV lesion, died a week after the operation with pneumonia as the main cause of death, but this infant also had a congenital heart lesion. A third patient, whose malformation was of Type I, died a month after the operation. There was considerable technical difficulty with the gastrostomy on account of the extremely small size of the stomach. The blind end of the lower segment of the esophagus was a little over a centimeter above the diaphragm, making a primary anastomosis of the esophagus out of the question. In a fourth case, one of Type IV, death occurred on the fifth postoperative day with pneumonia as the main cause. In a fifth case, of Type V, the patient died on the fifth day of life. Death was due to pneumonia and failure to recognize a fistula extending from the upper esophageal segment to the trachea.

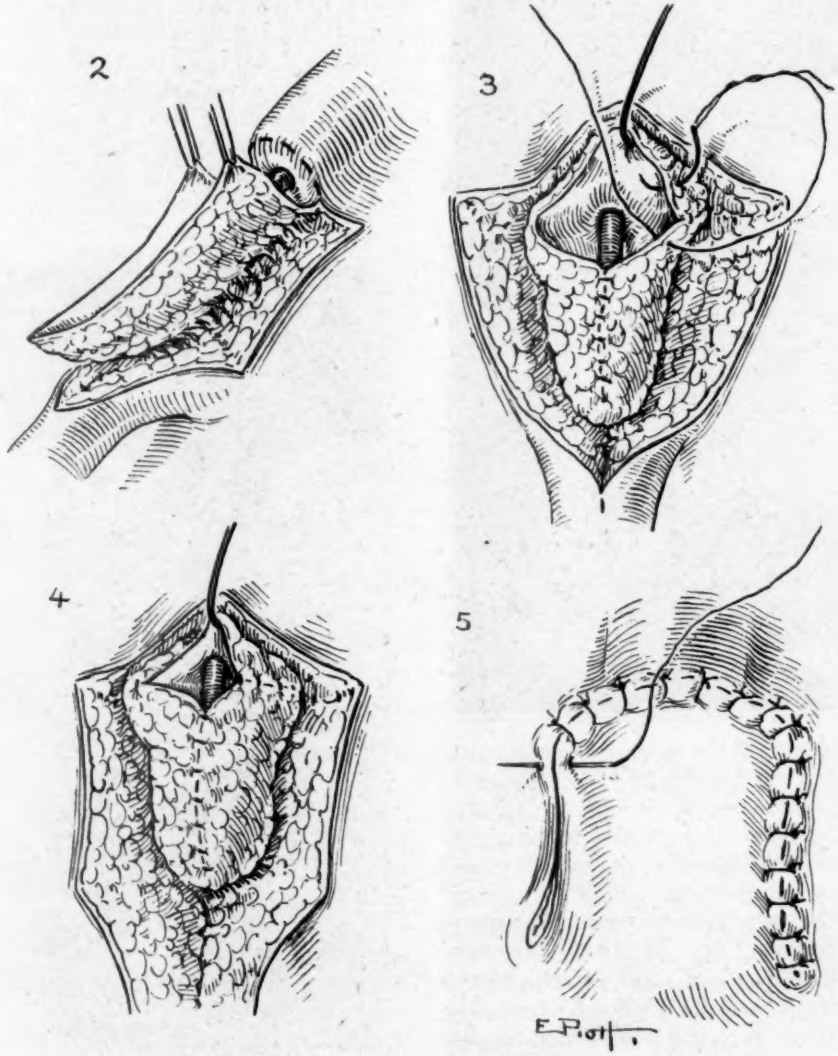

FIGURE 14. *Final Step of the Operation for Types III and IV.*
2 shows the flaps' being elevated to form the epithelial-lined tube; 3 and 4 show their being sutured to the previously made epithelial-lined tube; and 5 shows the raw surface's being covered by the tube graft and being sutured.

A sixth patient, with a Type IV anomaly, did extremely well for a month after the tracheoesophageal fistula was tied off, the upper segment of the esophagus had been marsupialized and a gastrostomy had been performed. He gained in weight steadily and

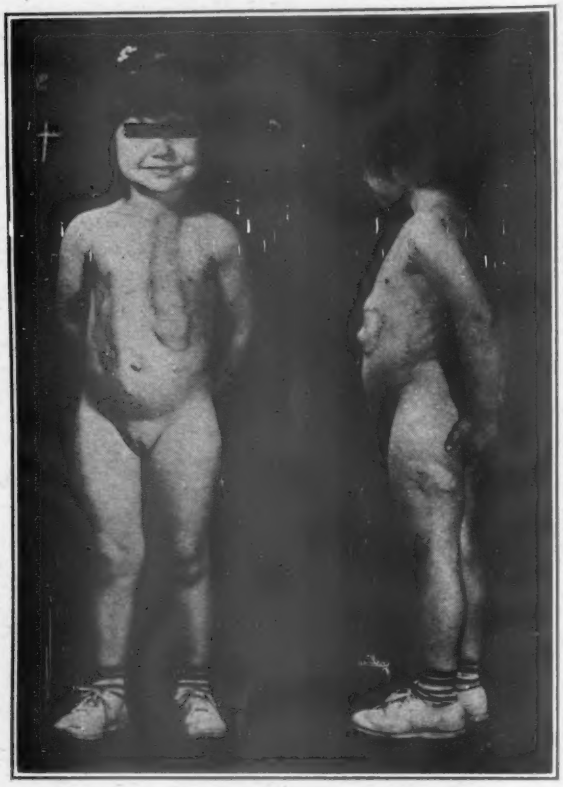

FIGURE 15. *Functioning Anterior Thoracic Esophagus in a Child Four Years Old Who Takes a Liberal Diet.*

was in excellent condition, but died suddenly of asphyxia that at post-mortem examination was found to be due to regurgitation of fluid fed through a recanalized tracheoesophageal fistula. The death of a seventh patient (Type IV) was most disappointing. This patient had done extremely well for three months and a half, when he became infected by an epidemic enteritis from which he died within twenty-four hours of its onset.

Of the 11 living patients, the oldest is now over four years of age. She eats a moderately varied diet and indulges in fairly normal activities for a child of her age. Her only complaint consists of occasional attacks of pain in the lower end of the new esophagus, apparently due to contraction of the gastrostomy opening, which requires dilatation. The next oldest patient is a little over two. The anterior thoracic esophagus has been completed, but there is a pin-sized leak that is slow in healing. The third oldest patient is seventeen months old, is in excellent health and is in the process of having his anterior thoracic esophagus constructed. The other 6 patients, who have been operated on by the three-stage method with the anticipation of constructing an anterior thoracic esophagus, are seven months, five and three-quarter months, five and a half months, three and three-quarter months, two and a half months and one and a quarter months old, respectively. They are all doing well and gaining in weight regularly. It is worthy of note that the last two patients were born a few weeks prematurely weighing 4 pounds, 6 ounces, and 4 pounds, 10 ounces, respectively.

Of the 2 living patients on whom a direct anastomosis was done, one is a little over seven months old and the other is five months old. The older of these is being fed entirely by mouth, is gaining in weight and is doing well. The younger patient is still being fed partially by mouth and partially

FIGURE 16. *Seven-Month-Old Baby with a Direct Anastomosis. All feeding is done by mouth, and the infant weighs over 15 pounds.*

by gastrostomy. He has had some respiratory difficulty, but this is improving and he is gaining in weight (Fig. 16).

SUMMARY

From our experience and that of others, it seems fair to conclude that atresia of the esophagus with or without tracheoesophageal fistula should no longer be considered as a hopeless condition carrying with it a 100 per cent mortality. It also seems justifiable to predict that if obstetricians and pedi-

atricians are on the alert for making an early diagnosis, the mortality will be further lowered.

It should also be stated that the surgical methods for combating this condition are subject to change. At the present time, however, primary anastomosis of the esophagus appears to be the operation of choice when the two ends of the esophagus can be approximated without too much tension. In other cases, where the ends of the esophagus are far apart, the three-stage operation with the ultimate construction of an anterior thoracic esophagus is a safer operation. The last 5 patients operated on according to this plan are living and doing well.

I am indebted to Dr. Sidney Farber for his careful postmortem observations, and to Dr. Tague C. Chisholm for reviewing the literature and tabulating the statistics.

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HEREDITARY HEMORRHAGIC TELANGIECTASIA*

An Analysis of Capillary Heredopathies

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THE hereditary hemorrhagic diatheses constitute an interesting group of relatively rare conditions that, in general, may be considered to fall into three main groups. The first group includes conditions characterized by hereditary disturbances in the plasma components of the hemostatic mechanism, and is exemplified by hereditary hypofibrinogenemia and probably hemophilia. In the second group are placed those hereditary conditions showing alteration in the platelets. This alteration may be a quantitative diminution (hereditary thrombocytopenic purpura) or a qualitative change in platelet function (thrombasthenia). The third group comprises the hereditary disorders of capillary structure and functions — the capillary heredopathies. They are transmitted by, and appear in, both sexes. All hitherto described capillary heredopathies present a normal platelet count and normal clotting and prothrombin times. The usual classification of these disorders is in terms of the results obtained by various functional tests, such as the bleeding time and the tourniquet test. Three capillary heredopathies are ordinarily considered well-defined entities; these are pseudohemophilia, hereditary familial purpura and hereditary hemorrhagic telangiectasia.

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Pseudohemophilia (Glanzmann,[1] Morawitz, and Jürgens[2] and von Willebrand and Jürgens[3]) is characterized by an increased bleeding time. The tourniquet test may be positive or negative, and it is claimed that in some cases clot retraction is defective. The latter findings, however, vary not from case to case but from family to family. Epistaxis, spontaneous ecchymoses, prolonged bleeding after operation, spontaneous bleeding from mucous membranes and an onset in early life with decreasing severity in later life are the usual clinical manifestations.

Hereditary familial purpura simplex (Davis[4, 5]) is characterized by the appearance of spontaneous ecchymoses and a positive tourniquet test but a normal bleeding time. Further clinical observations included a low incidence of other forms of spontaneous bleeding and frequent association with rheumatoid arthritis and rheumatic fever. A family described by Davis[4] had hereditary hemorrhagic telangiectasia as well as hereditary familial vascular purpura.

Hereditary hemorrhagic telangiectasia (Rendu,[6] Osler[7, 8] and Weber[9]) is the third of the well-demarcated capillary syndromes. It is characterized by a normal bleeding time and typical gross disseminated capillary abnormalities. A negative tourniquet test is usually included as a diagnostic criterion. The characteristic angiomas are composed of

dilated small vessels that histologically comprise a single layer of endothelium with a conspicuous deficiency of the muscular and elastic layers of the vessel wall.[10–12] Clinically, bleeding, particularly epistaxis, usually begins at about the second decade of life. Visible telangiectases, which in most cases bleed with minimal trauma, appear somewhat later. Telangiectases are most frequently found in the nose and mouth and on the face, neck and hands. All other organs, including the viscera, may be involved. In one family not only a tendency to telangiectasia but also a monosymptomatic location in the lung was inherited.[13] Severe cases are associated with hypochromic microcytic anemia, splenomegaly and, more rarely, hepatomegaly.

Any attempt to classify hereditary hemorrhagic disorders in general, and capillary heredopathies in particular, encounters certain difficulties. These are partly due to uncertainties in the interpretation of the mechanism of the various tests on which separation of these syndromes is based, and partly due to coexisting combinations of various types in the same family (Fig. 1).[14] For example, it has been noted that some pseudohemophilic families show a positive tourniquet test as well as a prolonged bleeding time, whereas others show only a prolonged bleeding time. Some families are said to have deficient clot retraction, whereas in others the clot retraction is normal. Furthermore, combinations of thrombocytopenia with capillary disorders may be seen.[15]

This paper describes a family in which the typical lesions of hereditary hemorrhagic telangiectasia, together with a positive tourniquet test, were present in all members examined.* Since the presentation of rare and unusual syndromes is chiefly of value for the light that it throws on general pathologic physiology, an attempt is made to discuss the underlying mechanisms of the capillary heredopathies.

Case Reports

Case 1. R. Z., an 80-year-old woman, came under observation because of repeated spontaneous epistaxis over a period of 40 years. Cauterization of the nose 7 years previously had afforded relief for only 6 months. For 30 years she had noted red spots on the ends of the fingers and on the mucous membranes of the mouth. There were no spontaneous ecchymoses, nor was there increased bleeding after minor injury. Before the menopause, which occurred at the age of 45, the menses had not been unusual except for slight hypermenorrhea. A careful investigation of the nutritional background revealed a diet that was qualitatively and quantitatively adequate. There had been occasional attacks of migraine at the menstrual period; these ceased at the menopause. The history was otherwise noncontributory, except for some episodes of acute arthritis 20 years previously.

Physical examination revealed a well-developed, well-nourished woman who looked and acted much younger than her age. On the roof of the mouth, the frenulum of the tongue, the palm, the fingers and to a lesser extent the forearm were found the typical lesions of telangiectasia. The mouth and teeth were in excellent condition. Except for Heberden nodes on the fingers, no pertinent physical findings were noted.

While the patient was under observation the temperature varied from 97.0 to 98.6°F., and the pulse from 70 to 80. Several blood-pressure determinations ranged closely about 140/60. Repeated urinalyses were negative.

The red-cell count was 4,100,000, with 3 per cent reticulocytes, and the hemoglobin was 14 gm. (90 per cent). The white-cell count was 9100, with 5 per cent staff cells, 67 per cent neutrophils, 21 per cent lymphocytes, 4 per cent monocytes and 3 per cent eosinophils. The color index was 1.08. The hematocrit was 38 and the mean corpuscular volume 92 cubic microns. The platelet count was 220,000 (Rees-Ecker method). Clot retraction was normal. The prothrombin time was 20 seconds (normal, 18 seconds) (Quick method). The bleeding time was 2 minutes (Duke method), the clotting time 4 minutes (Lee–White method) and the sedimentation rate 9 mm. in 1 hour (Wintrobe method).

A tourniquet test was performed by placing a blood-pressure cuff on the upper arm and inflating it to halfway between the systolic and the diastolic pressure. After 15 minutes, the number of petechiae were counted in a circle 2.5 cm. in diameter that had been drawn on the flexor surface of the forearm 4 cm. below the bend of the elbow. No petechiae were found in this area before beginning the test, and 60 to 70 were found after testing; the test was therefore distinctly positive, since 10 petechiae are considered to be the upper limit of normal.[16]

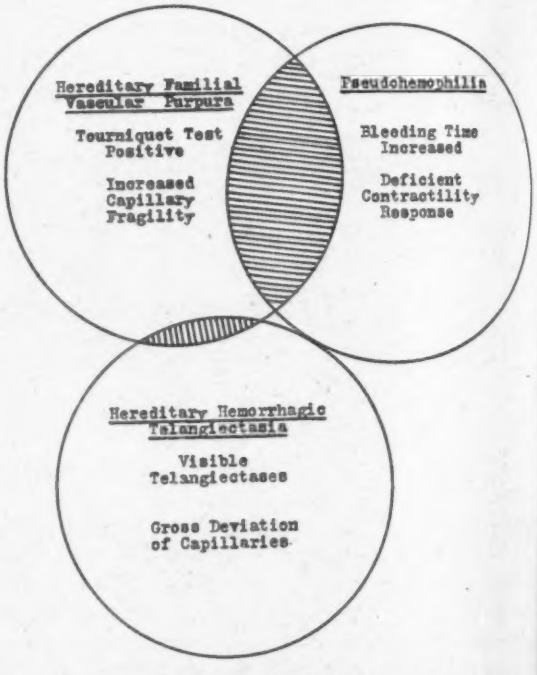

Figure 1. *Diagram Illustrating the Various Pure Types and the Reported Combinations of Hereditary Capillary Syndromes. The shaded areas represent the observed combinations and their respective frequencies. An association of increased bleeding time (pseudohemophilia) and gross deviation of capillaries (telangiectasia) has not yet been reported.*

Further investigation revealed a strong familial and hereditary tendency to telangiectasia (Fig. 2). The patient's father had had marked telangiectasia and epistaxis, which was occasionally severe enough to lead to fainting. Because the patient left home at an early age, no information about her father's further history was available, nor could information about earlier generations be secured. There were two sons, the younger of whom died of diphtheria at the age of 2. The elder was asymptomatic until the age of 22, when epistaxis commenced. It is interesting to note that he had been able to play

*We are indebted to Drs. James Burns and Ralph Manning for permission to report these cases.

the trombone until this time but was then forced to stop because it induced epistaxis. Typical telangiectases developed later, but bleeding never became so severe as that of the mother. This son died at 55 of peritonitis.

There are reports on 66 members of the family (33 males and 33 females), 16 of whom (8 boys and 8 girls) have telangiectasia (a certain number are too young to show lesions as yet). The sex incidence, therefore, is not remarkable.

Certain other interesting details were encountered. In one line, telangiectasia was present in the first generation but not in the second or third, and reappeared in the fourth generation. This so-called "atavistic" skipping has been described by Fitz-Hugh.[17] One instance of intermarriage within the family was noted. In this case, a girl of the third generation with telangiectasia married her first cousin, of the third generation, who did not have telangiectasia. There were two children — a hypermature stillbirth and an infant with complete spina bifida. The association of hereditary hemorrhagic telangiectasia with anomalies of the vertebral column has previously been reported.[18-20]

Unfortunately, this family had become spread throughout the United States and only 2 other members (Cases 2 and 3) could be examined.

Case 2. T. C., a 49-year-old, married woman has had repeated spontaneous epistaxis since the age of 11. Telangiectatic lesions appeared on the hands in the 30th year, and a much more extensive distribution developed at the menopause. There have been no spontaneous ecchymoses or increased bleeding after small injuries, but the patient bruises easily. At the age of 37 she had "arthritis," which was relieved after tooth extraction, and she had hay fever, asthma and urticaria. The menses were regular and were not remarkable except for some hypermenorrhea. The menopause occurred at the age of 45.

Physical examination revealed the typical lesions of hereditary telangiectasia on the face and hands and in the mouth. A telangiectasis was also found under the nail of the left 5th toe. The physical findings were otherwise noncontributory.

The red-cell count was 5,280,000, and the hemoglobin was 14.8 (95 per cent), giving a color index of 0.9. The white-cell count was 7500, with a normal differential pattern. The platelet count was 250,000. The bleeding time was 2½ minutes, and the clotting time 4 minutes. A tourniquet test was distinctly positive.

A number of siblings have migraine and the patient herself had had a few attacks in early adulthood. Her 3 children have epistaxis. The youngest son, aged 25, has already developed telangiectasia on the hands.

In comparing Case 2 with Case 1, it was noted that the tendency to bleed from the visible telangiectases and the tendency to easy bruising were more marked in the former. Epistaxis was more marked and the tourniquet test was somewhat more strongly positive in the latter. In Case 3 (below) similar findings were present, but the tendency to easy bruising was even more prominent and the tourniquet test was the most strongly positive of the 3 cases.

Case 3. C. M., a 46-year-old housewife, reported repeated spontaneous epistaxis beginning at the age of 8. Telangiectases on the hands were first noticed at 20, and increased in number with increasing age. The patient bruises easily. She occasionally bleeds from telangiectases on the tongue and lips. The menses are regular, but there is marked hypermenorrhea.

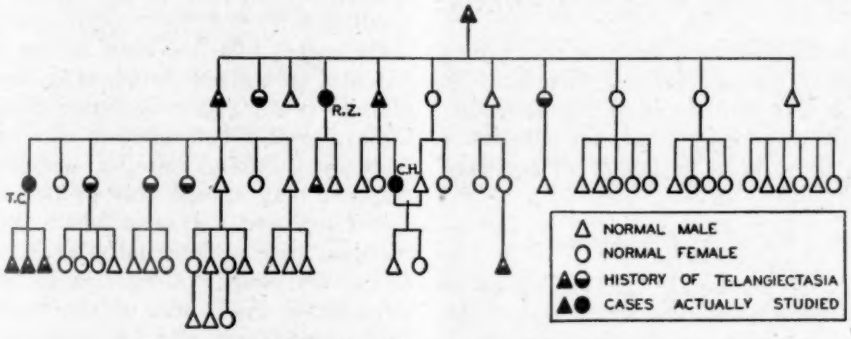

Figure 2. *The Family Tree.*

The patient married her first cousin, who, although in the direct line of descent, was not afflicted with telangiectasia. There were three pregnancies. One was terminated by spontaneous miscarriage, one child of 13 pounds was stillborn, and the other lived only 3 days after birth. The description of one of these children is compatible with complete spina bifida.

Physical examination revealed a well-developed, well-nourished woman who presented the typical lesions of hereditary telangiectasia on the hands, tongue, lips, face and the mucous membranes of the buccal cavity. No other significant physical findings were elicited.

The red-cell count was 4,600,000, the hemoglobin 14.3 gm. (92 per cent), the color index being 1.0. The white-cell count was 7800, with a normal differential pattern. The platelet count was 325,000. The bleeding time was 2 minutes, and the clotting time 3½ minutes. A tourniquet test was strongly positive.

Discussion

Occurrence of Positive Tourniquet Tests in Hereditary Telangiectasia

The outstanding peculiarity of this family is the occurrence of a positive tourniquet test in a syndrome in which a negative tourniquet test is ordinarily considered a diagnostic criterion. For example, the tables given for the differential diagnosis of the hereditary hemorrhagic diatheses in current textbooks of hematology[21-23] include this as an important item. Although only 3 members of the family could be examined, the occurrence of the unusual combination of a positive tourniquet test with telangiectasia in all of them makes it likely that both abnormal capillary manifestations were present on a hereditary basis.

A review of the literature on hereditary hemorrhagic telangiectasia of the last ten years shows that most of the authors reporting cases[12, 24–31] do not mention having performed a tourniquet test or suction test. Five authors[10, 18, 32–34] report performing tourniquet tests in 9 cases. The result was negative in 8 cases and questionable in 1.

The only report of an unequivocally positive tourniquet test that can be found is that of Davis,[4, 5] who in his study of hereditary familial purpura simplex reports a family with spontaneous ecchymoses, a positive tourniquet test and typical lesions of hereditary hemorrhagic telangiectasia. These findings are similar to those in our family, except that our patients do not show spontaneous purpuric lesions.

Whether the association of a positive tourniquet test with hereditary telangiectasia is fortuitous or is indicative of a more fundamental capillary disturbance presents a problem that necessitates a brief analysis of the clinical pathology of capillary heredopathies.

Clinical Pathology of Capillary Heredopathies

In considering capillary functions it is important to distinguish three variables: the contraction of the capillaries following injury (contractility response), the resistance of the capillaries to pressure (capillary fragility) and gross deviation in the histologic structure of the capillaries (telangiectasia). It will be seen that although disturbances of these factors most often occur separately, defects frequently coexist.

Contractility response of capillaries following injury. Following an injury to the capillaries, bleeding stops because of a complicated process involving contraction of the capillaries and plugging of the endothelial defect by a platelet thrombus. MacFarlane,[35] to whom much of the credit for the modern concepts in this field must be given, believes that the capillary contraction is the more important process. Prolonged bleeding following capillary injury may therefore be due to diminished contractility, or to quantitative or perhaps qualitative alteration of the platelets, or to a combination of these factors.

Clinically, a prolonged bleeding time is seen in such conditions as thrombocytopenic purpura of various etiologies and in conditions with apparently normal platelets but an abnormal contractility response. In pseudohemophilia, the platelet counts are normal, but deficient capillary contractility has been demonstrated by MacFarlane. The earlier concept of pseudohemophilia, as developed by von Willebrand and Jürgens,[3] Morawitz and Jürgens[2] and others, favored a qualitative alteration of platelets with diminished ability to form a thrombus. Serious doubt has been cast on the validity of this concept. Buckman,[36] for example, found that a suspension of platelets obtained from a pseudohemophilic patient produced as rapid a coagulation of hemophilic blood as did the platelets from a healthy person. At present, although the possibility of qualitative platelet alterations is still undecided, the capillary dysfunction in pseudohemophilia is well established. That diminution of platelets alone does not lead to purpura unless accompanied by capillary damage has been experimentally demonstrated. Roskam[37] injected gelatin intravenously into dogs and reduced the platelets to extremely low levels with only a slight or no increase in bleeding time. Bedson,[14] using a solution of agar, obtained similar results. If, however, injections of antired-cell serum preceded the lowering of the platelets, purpura resulted. Antired-cell serum, according to Bedson, damages the capillaries.

Prolonged bleeding time in the presence of apparently normal platelets — as indicated by a normal platelet count and coagulation time — is therefore indicative of a deficiency in capillary contractility response. Furthermore, a deficient contractility response may appear only in localized areas. Roskam[37] reported a case in which the patient had a bleeding time of three minutes in one ear lobe and one of forty-eight minutes in the other. It is not improbable that some of the cases of hereditary familial epistaxis without other detectable hematologic deviation[15] represent such localized areas of defective contractility response.

Response of capillaries to pressure. The capillary fragility expresses the resistance of the capillaries to pressure. This is best measured by a modern tourniquet test or by the more elaborate suction method.[16, 38, 39] These fragility tests depend on the integrity of the capillary endothelium. Clinical observations suggest some relation between platelets and maintenance of the capillary resistance to pressure. In the presence of a normal platelet count and coagulation time, however, a positive tourniquet test may be considered to reflect only an abnormal response of the capillaries to pressure.

Increased capillary fragility may be present with or without corresponding involvement of the contractility response. Since capillary fragility is measured by the tourniquet test, a prolonged bleeding time may therefore be seen with or without a positive tourniquet test, and similarly a positive tourniquet test may be seen independently of an increased bleeding time. A decrease in capillary resistance without a disturbance in contractility response was described by Davis[4, 5] as hereditary familial vascular purpura. A disturbance in contractility response without a change in capillary resistance is seen in certain pseudohemophilic families.

As yet, localized disturbances of capillary resistance have not been described, probably because the tourniquet test, which has been most widely used for testing capillary resistance, is ordinarily performed only on the upper extremities. With the

introduction of suction tests, however, it will become possible to study localized variations. Analysis of capillary contractility response and fragility, together with their occurrence in clinical observations, have therefore shown that they must be considered as independent variables.

Gross deviation of structure of capillaries. Areas of gross deviation of capillary histologic structure are seen in hereditary hemorrhagic telangiectasia as localized, disseminated lesions. The gross pathology and histopathology have already been described.

The usual form of gross deviation, or typical hereditary hemorrhagic telangiectasia, occurs as multiple lesions in various capillary provinces, but localized single lesions of hereditary telangiectasia are sometimes seen. Libman and Ottenberg[13] described a family in which a single lesion in the lung occurred as a familial characteristic.

As a rule, the nonaffected areas in this disease show a normal contractility response and fragility, whereas bleeding time after injury to a telangiectasis is considerably prolonged.[22] In certain cases, however, gross deviation of the capillaries is combined with more or less developed abnormalities of contractility response or capillary fragility, precisely as defects in contractility response and fragility are associated. Our family and that reported by Davis[4, 5] show such a combination of hereditary hemorrhagic telangiectasia with abnormal capillary fragility. The sole difference is that Davis's family showed spontaneous ecchymoses, whereas the increased fragility in our cases was not sufficient to lead to purpuric manifestations. The combination of hereditary hemorrhagic telangiectasia with prolonged bleeding time (deficient contractility response) has not yet been reported, but on the basis of this analysis it may be considered possible.

As can be seen from this discussion, definite pure types of capillary dysfunction are sometimes observed. On the other hand, the diagnosis of a clinical picture in any case of hereditary capillary disorder should depend on analysis of the involved pathologic physiology. Such analysis shows the existence of an interrelated system of capillary functions that may be singly or simultaneously involved. This approach precludes the use of tables of differential diagnosis for these disorders in which only rigidly demarcated types are considered. In the various manifestations of acquired capillary dysfunctions, toxins, nutritional deficiencies (vitamin P deficiency), endocrinopathies and so forth play a role as etiologic factors. No clue is available concerning the mechanism by which the hereditary manifestations are brought about.

Summary

A family presenting hereditary hemorrhagic telangiectasia, together with a positive tourniquet test, is described. An analysis of the pathologic physiology of capillary heredopathies is attempted. An abnormal contractility response of a capillary to injury as expressed by a prolonged bleeding time and an abnormal capillary fragility to pressure, as seen by a positive tourniquet test, represent independent variables that may be singly or simultaneously involved.

Pseudohemophilia is characterized by a prolonged bleeding time but a negative tourniquet test, and hereditary purpura simplex by a normal bleeding time but a positive tourniquet test. Combinations of both types exist.

Hereditary hemorrhagic telangiectasia is a localized gross abnormality of capillaries usually not accompanied by any systemic capillary dysfunction. The observed family represents, however, such a combination of localized gross deviation of capillary structure and increased capillary fragility.

The diagnosis of hereditary capillary syndromes should depend on physiologic analysis and not on rigidly demarcated types of disorders.

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MEDICAL PROGRESS

ENDOSCOPY*

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I SOMETIMES wonder whether the general practitioner thinks that the endoscopist, peeking through narrow tubes, is "learning more and more about less and less," but when I come to review the voluminous literature on the subject, I realize each year more than ever how many interesting branches of medicine and surgery are involved. Undoubtedly the endoscopist sees a large percentage of the most interesting problem cases in the hospital. Through bronchoscopy and esophagoscopy he is constantly in touch with the new and ever-widening field of thoracic surgery. When he uses the gastroscope, he is endeavoring to confirm or establish gastric diagnoses that might otherwise be obscure or unattainable. Last, but not least, by the use of the peritoneoscope he is differentiating many difficult abdominal problems and establishing a positive diagnosis by biopsy. A review of the literature may help the clinician in deciding when to call the endoscopist in consultation.

ANESTHESIA

There have been a number of verbal reports regarding the toxicity of pontocaine as a topical anesthetic during endoscopy. In last year's progress report[1] a nonfatal reaction was reported. Hansen and Stealy[2] report a sudden death following the use of pontocaine as a gargle anesthetic. The patient was a man of fifty-four who had received 1½ gr. of pentobarbital sodium orally one hour before, and ¼ gr. of morphine sulfate fifteen minutes before the operation. While gargling 1 dram of 2 per cent pontocaine, he suddenly collapsed. Respiration ceased, cyanosis developed and there was a generalized convulsion, followed by several more convulsions during the next hour. In spite of artificial respiration and the administration of luminal sodium, adrenalin, coramine and oxygen, death ensued one hour and a quarter after the collapse. A post-mortem examination revealed a carcinoma of the esophagus with extensive metastases to the liver, but no organic reason for the sudden death could be demonstrated. Because of the manner in which death occurred, and the absence of any other demonstrable cause, it can be concluded only that death was due to an anaphylactic reaction to the pontocaine gargle.

In the clinic at the Massachusetts General Hospital a 4 per cent cocaine for all peroral endoscopies is being used. No reaction to 5 per cent Larocaine Hydrochloride has been known to occur but at the present time this drug cannot be obtained.

In an editorial on modern anesthesia, Lahey[3] states that the anesthetist should recognize the importance of keeping the tracheobronchial tree free of secretions and other fluid, and should be prepared and able to remove these secretions before, during and after operation; in other words, he should be familiar with the technic of bronchoscopy and should be able to recognize when this procedure is indicated.

BRONCHOSCOPY

Anatomy. Jackson and Huber[4] have studied the anatomy of the bronchial tree and lungs with reference to the branching into lobar segmental bronchi and the relation of each lobar and segmental bronchus to its corresponding portion of lung. A nomenclature has been proposed that is quite similar to that suggested by Adams and Davenport.[5]

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Diverticulum of the bronchus. Diverticulum of the bronchus is exceedingly rare. Arce[6] reports an interesting case that was well demonstrated by bronchography.

Bronchiectasis. Goodale[7] reports 75 cases of bronchiectasis that were studied to evaluate the importance of surgical treatment of the sinuses. The best results were obtained from lobectomy in cases in which there was no complicating sinusitis. Untreated sinusitis was a distinct hindrance to recovery from the thoracic infection. Likewise, in cases in which the sinuses were operated on but lobectomy was not done, the result was poor. When both adequate operation on the sinuses and lobectomy can be performed, the results are so much better that these two procedures are indicated in all suitable cases. That Goodale's cases were hard to classify may be considered evidence that each patient must be considered separately.

In reporting on 76 patients surgically treated for bronchiectasis, Bradshaw and O'Neill[8] mention that more and more patients with bilateral disease are being subjected to bilateral lobectomy, with considerable success (Eloesser, Lewis, Overholt, Bradshaw and Chodoff, Blades and Graham). Several patients have had three and a part of a fourth lobe removed successfully. The operative mortality in this group of patients is, of course, much higher than that in the unilobar group.

DeBakey and Ochsner[9] have also written on the surgical treatment of bronchiectasis, calling particular attention to Churchill's[10] recently reported series of 125 cases in which lobectomy was performed with a mortality of only 2.4 per cent. The operative mortality is lowest with children and increases with age. The authors use bronchoscopic aspiration following the operation. The decreased postoperative morbidity resulting from the removal of viscid mucopurulent secretions by this means has convincingly demonstrated its value.

Blades and Dugan[11] have demonstrated that, following atypical pneumonia, iodized oil bronchograms occasionally give the erroneous impression of a true bronchiectasis. According to them, if one is aware that atypical pneumonia is capable of producing temporary dilatation of the bronchi, an early or dry bronchiectasis can for a time be considered a pseudobronchiectasis. Progression of symptoms and repeated demonstration of the bronchial dilatation soon establish the correct diagnosis. Failure to consider the possibility of pseudobronchiectasis may result in unnecessary resection of lung tissue.

Vinson,[12] in a discussion of the management of chronic suppurative pulmonary disease, states his belief that any patient with suppuration should have at least one bronchoscopic examination to determine the exact location and distribution of the area of infection. When bronchial stricture is present, adequate drainage can be often provided by bronchoscopic methods, with beneficial or curative results. Insufflation of powdered sulfanilamide through the bronchus has been of benefit in patients with chronic suppuration. My own experience indicates that sulfadiazine by mouth is equally effective.

Clerf[13] believes that although bronchiectasis can be cured by conservative measures, this can be considered only if the cases are observed early, before the bronchial mucosa or bronchial wall has been damaged by the infective process. Excellent results have been obtained in patients with minimal bronchiectasis secondary to aspirated foreign bodies. Following removal of the foreign body and repeated bronchoscopic aspiration of secretions, definite regression of the bronchial dilatation has been observed. Too often, however, the diagnosis is not made sufficiently early to permit such a plan of treatment. Patients commonly present themselves with well-defined bronchiectasis involving one or more pulmonary lobes or both lungs. Clerf calls attention to the fact that bronchiectasis is a common chronic pulmonary disease, being oftener observed than is pulmonary tuberculosis. Surgical extirpation of the diseased lung tissue effects a cure. All other methods of therapy are only palliative. He lays considerable stress on the importance of bronchoscopy as an aid in the prevention of bronchiectasis through the removal of bronchial obstruction. Bronchoscopic aspiration of secretions from infected areas aids patients who are too old for surgery or have bilateral lesions that render surgical treatment impractical.

In discussing the sulfonamides in relation to bronchial secretion, Norris[14] states that the general effect of sulfonamide compounds is favorable, particularly when combined with bronchoscopic aspiration. He writes as follows:

> We have tentatively preferred the oral method of administration because of comfort and convenience from the patient's standpoint and because its use presumably allows a much more diffuse, uniform and prolonged action than can be obtained by instillation or a series of instillations. . . .
>
> The persistence of symptoms and progression of disease in bronchiectasis are due in the main to chronic infection. It has appeared to us that this factor can be most directly attacked by combining a measure which improves bronchial drainage and prevents stagnation [bronchoscopic aspiration[15]] in a rather intensive course with specific antibacterial therapy. This means, in most cases, hospitalization for a period of from seven to ten days. . . .
>
> The concentration of sulfadiazine in bronchial secretion during oral administration is approximately 60 per cent of the blood level. This ratio is apparently not materially affected by the extent of bronchial disease or the amount of expectoration.
>
> After intratracheal or intrabronchial instillation of 5 per cent aqueous suspension of microcrystalline sulfathiazole, significant concentrations persist in the bronchial secretion for twenty-four to forty-eight hours. The concentrations are larger, as would be expected, in cases in which there is but little expectoration.
>
> Elimination of 2.5 per cent aqueous solution of sulfadiazine following intratracheal or intrabronchial instillation appears to be much more rapid, the amounts remaining at the end of twenty-four hours being negligible.
>
> Combined sulfonamide and bronchoscopic treatment in 10 cases of acquired bronchiectasis resulted in a con-

siderable reduction in daily sputum volume, with favorable alterations in the bacterial flora.

The plan of treatment described should prove of definite value as a preliminary to lobectomy or pneumonectomy for suppurative disease. It is probably worthy of trial in cases of well established nonsurgical bronchiectasis.

Dowling and Lepper[16] have studied the toxic reactions following the use of sulfapyridine, sulfathiazole and sulfadiazine, and conclude that the optimal therapy for most infectious diseases at the present time involves the use of sulfadiazine, in low doses whenever possible but in high doses when necessary, provided there are careful regulation of fluid intake and output and frequent blood counts and urinalyses, combined with close observation of the patient.

Acute tracheobronchitis with edema. Baum[17] reports that acute laryngotracheobronchitis often produces death by inflammatory edema of the subglottic tissues. Concentrated plasma is effective in reducing this edema, which it accomplishes by its high concentration and resultant osmotic action. Such action withdraws fluid from the tissues into the blood stream. It is in no way curative for the infection.

Schmidt[18] calls attention to the importance of benign nontuberculous bronchial stenosis, which may develop secondary to chronic bronchial infection such as that seen in cases of chronic asthmatic bronchitis. Secondary and tertiary bronchi are principally involved, and occasionally primary bronchi. The syndrome of benign nontuberculous bronchial stenosis is a definite one. There is usually a history of antecedent pneumonia, severe tracheobronchitis or repeated seizures of asthmatic bronchitis. After variable periods, recurrent bouts of chills, fever and general malaise develop. The period of fever is usually preceded by an irritating nonproductive cough. The temperature may reach 102 to 103°F., the elevation persisting for two to seven days, at the end of which time variable amounts of purulent secretion are coughed up. This relieves the symptoms. At times the sputum is blood tinged. Bronchoscopy is the only clinical method of determining whether benign bronchial stenosis exists, and it is the only way by which such a lesion can be satisfactorily treated. In one of the cases reported, a bronchogram showed bronchiectasis of the left lower lobe in a patient forty-seven years old. Fifteen months later it had cleared up entirely so that bronchography disclosed no abnormality. In 15 of the 25 cases, bronchial stenosis was secondary to asthma or asthmatic bronchitis. In a certain number of cases the stenosis recurs and it is necessary to repeat bronchoscopic dilatation.

Asthmatoid respiration. Friedberg[19] has discussed bronchoscopy with relation to asthmatoid respiration. In 8 of his cases there was noisy breathing or wheezing, and in some of them there was a misleading familial history. A number of the cases were due to foreign bodies in the bronchus, whereas others were due to large amounts of secretion, to bronchial stenosis or to tuberculosis. Friedberg concludes as follows:

Altered respiration of an asthmatoid type may result from a variety of clinical conditions which produce changes in the caliber of the tracheobronchial lumen.

Pathologic narrowing of the bronchial lumen, coupled with physiologic shortening and contraction of the bronchi, probably combine to produce an abnormal vibration of the outgoing air during expiration. The resultant sound is often wheezing in character.

Illustrative cases indicate the diagnostic and therapeutic value of bronchoscopy in simulated asthmatic breathing.

Endoscopic investigation is warranted in any case of atypical bronchial asthma which does not respond readily to diagnosis and therapy.

Foreign bodies. Holinger[20] reports 5 cases in which confections caused severe obstruction to the airway in children. He calls particular attention to the danger of aspiration of candy or gum in children during rapid respiration. A positive history with physical findings of laryngeal, tracheal or bronchial obstruction establishes the diagnosis.

Bronchial obstruction. Having recently had 2 patients in whom aneurysm of the descending aorta was causing complete obstruction of the left main bronchus with atelectasis of the left lung, I think it is worth while to call attention to the x-ray diagnosis of such lesions by angiocardiography as discussed by Steinberg, Grishman and Sussman.[21] Aortic aneurysm as a cause of bronchial obstruction is rare, but should naturally be recognized before bronchoscopy is undertaken. Bronchoscopy in aneurysm may be a harmful procedure, and biopsy of the obstructing lesion is almost certain to prove fatal.

Importance of the cough reflex. The importance of preserving the cough reflex in all diseases of the lung cannot be overemphasized. The cough is the "watchdog of the lung" and enables the patient to raise secretions that if left stagnant are definitely harmful. Many physicians, however, unnecessarily order cough medicines that seem to abolish the cough reflex. Occasionally, of course, sedation is necessary to abolish pain. In this connection Johnson[22] discusses postoperative pain following total pneumonectomy. He writes as follows:

One's natural impulse is to give patients sufficient morphine to relieve the pain. However, this incurs the danger of diminishing the cough reflex to such an extent that secretions accumulate in the tracheobronchial tree. In one instance, this resulted in atelectasis of the right upper lobe after a left total pneumonectomy. Such a complication may be overcome only by the most energetic treatment.

If, on the other hand, one avoids sedation too long, the patient's life may actually be threatened as a consequence. In at least one patient, the sedation was held off too long for fear of diminishing the cough reflex. Because of pain, the patient began taking shallow rapid respirations. He allowed secretions to accumulate in his tracheobronchial tree to avoid the pain of coughing. Because of these two factors he developed an anoxia and from it went into shock. When a large dose of morphine was given, the pain was sufficiently relieved to allow the patient to cough up the secretion and take deep, even respirations. Having overcome the anoxia, the patient rapidly recovered from the shock with the aid of intravenous fluids.

It has been found therefore that one must proceed carefully along the middle road between too much morphine and too little morphine, either extreme having potentially fatal complications. However, even with the most careful attention, it may often be impossible to reach a stage of sedation which will relieve the patient's pain adequately, and still not depress his cough reflex and respiratory rate to a dangerous degree

Trauma. Foss and New[23] report a case of traumatic stenosis of the larynx in which the normal lumen of the larynx or upper portion of the trachea was occluded by scar tissue. This condition was treated by a new type of obturator constructed of veronite. Among the advantages of this method are that the device can be worn with comfort, that there is no formation of granulation tissue within the larynx, that there is no discharge and consequently no odor and, that the obturator may be cleaned as an office procedure.

Adenoma. Anderson[24] reports a case of so-called "adenoma" with metastases to the liver. The bronchial tumor alone would have been considered benign, but on the finding of metastases in the liver was diagnosed as malignant. In view of this case the author believes that the principle of treatment of bronchial adenoma should be the same as that of malignant tumor. There are undoubtedly borderline cases, but, as pointed out in last year's review[1] the term "malignant adenoma" seems to be somewhat of a contradiction in terms. Mulligan and Harper,[25] however, have also called attention to slow-growing tumors of the bronchus originally considered to be benign adenomas but shown by later biopsies to be adenocarcinomas. Such tumors must be watched carefully. Lobectomy or pneumonectomy may be indicated in these cases, not only because of the remote possibility of histologic change to malignancy but also because of irreparable lung damage or the existence of a large extrabronchial portion of the tumor.

Carcinoma. Cohen[26] reports an interesting case of obstructing emphysema and atelectasis in the same lung resulting from bronchogenic carcinoma. The tumor was so situated in the main bronchus as to occlude completely the orifices of the bronchi of the upper and middle lobes; simultaneously, it caused a check-valve type of obstruction of the bronchus of the lower lobe.

Mulligan and Harper,[25] in a detailed study of the morphology of primary carcinoma of the human lung, have discussed the pathologic anatomy in 45 cases. In 3 cases primary carcinoma was found in both lungs, which seems quite remarkable.

Robertson[27] reports that carcinoma of the lung ranks in frequency second only to carcinoma of the stomach, the death rate from this condition in Scotland having increased from 437 per 100,000 in 1935 to 559 in 1940. In the 52 cases reported, 37 patients were males and 15 were females.

Further evidence of the importance of bronchiogenic carcinoma is contained in an article by Overholt,[28] where it is stated that cancer of the lung is one of the most serious diseases of the chest in patients within the age period from forty to sixty-five years, particularly in men; that many patients seek help at a time when the lesion is still confined to the lung; that symptoms and signs are either lacking or misleading in the early stages; that the earliest lesions in almost every case produce some telltale shadow on the x-ray film; and finally that the diagnoses may be clinched in two ways — first, the majority of lesions are visible bronchoscopically and are accessible for biopsy and, second, when the suspicion cannot be verified in this way, it is possible to explore the chest safely by surgical means, settle the diagnosis and if necessary carry out curative treatment.

Fetter[29] also comments on the increase in frequency of primary carcinoma of the lung as shown in recent reviews. It appears that 10 per cent of all cancers start in the lung and that it is now the second most frequent site of origin of primary malignancy, the stomach being involved more than any other organ. In the United States about 15,000 people die from bronchogenic carcinoma every year. Many factors have been considered as possible causes of the disease: the influenza epidemic of 1918 (metaplasia of the bronchial mucosa has been found in patients dying of influenza); inhalation of irritating fumes, such as the exhaust from automobiles, the fumes from tarred roads or tobacco smoke (the fact that carcinoma of the lung is at least four times as frequent in men as in women has been cited in support of the tobacco-smoke theory); silicosis; tuberculosis; and other nonspecific lung infections, such as bronchiectasis and lung abscess. The author emphasizes the importance of early bronchoscopy in suspected cases and the fact that thoracotomies should be done only by those trained in thoracic surgery.

In the early diagnosis of carcinoma of the lung, Gowar[30] points out the value of sputum examination by the smear method of Dudgeon. The sputum should be coughed up the first thing in the morning so that there will be no contamination with food particles. Preservatives or disinfectants must not be added, and the specimen should be examined as soon as possible after collection. Specimens collected at bronchoscopy or coughed up shortly afterward are suitable for examination. Dudgeon advised that the sputum be poured onto an unglazed porcelain tile to concentrate it, but Gowar found that by examining it in a large Petri dish on a black background it was easier to pick out portions for examination. Blood-streaked fragments or the relatively solid portions are picked out with a platinum loop or scalpel and are spread thinly on a slide. Several slides are prepared from each sputum. They are fixed by immersing at once in a bath of Schaudinn's solution, leaving them there for twenty minutes and washing them for two minutes in 70 per cent alcohol containing a trace of iodine, to

remove the excess of mercury bichloride, and then in distilled water. The slides are stained with Mayer's hemalum for one and a half to two minutes, blued in tap water, counterstained with eosin for two minutes, dehydrated and mounted in Canada balsam. They are then examined with the low power of the microscope, and any suspected group of cells is submitted to a higher magnification. When the clinical evidence is strongly in favor of carcinoma, several specimens of sputum should be examined before a negative report is made. A negative report does not exclude malignant disease. Gowar used this method in 93 cases of suspected neoplasm of the lung. In 64 per cent of the cases he succeeded in demonstrating malignant cells. The cells were found not only in advanced cases but also in a significant proportion of those in which the growth was still operable. The test is of value in establishing malignancy when other methods of investigation, including bronchoscopy, have failed, when it is desired to explore the chest, when the patient is too ill to be submitted to other methods of investigation and when the growth is masked by secondary inflammatory changes in the lung. It is urged that the test be more widely employed and that aspiration biopsy be reserved for cases giving repeatedly negative sputum tests, not being used when surgical removal of the growth is envisaged.

Field and Quilliam[31] report the case of a four-and-a-half-year-old girl with primary bronchial carcinoma. She had always been in good health until eleven days before admission, when she developed an unproductive cough with periods of apnea. Physical examination revealed a cyanotic, dyspneic child and the presence of pleural effusion on the right, which steadily increased in spite of repeated thoracenteses. Examination of withdrawn fluid revealed many mesothelial cells suggestive of malignancy. On thoracoscopy many neoplastic nodules over the parietal pleura were seen, and histologic examination showed them to be infiltrating anaplastic carcinoma of the bronchial type. The patient expired two months after admission with evidence of metastases to the supraclavicular lymph nodes and also extension of the tumor to the chest wall. Autopsy revealed a carcinoma of the bronchus with extensive pleural involvement and metastases to the bronchial, mediastinal, right supraclavicular and axillary and celiac-plexus lymph nodes.

Metastatic pulmonary malignancy. Brezina and Lindskog[32] report the case of a sixty-five-year-old woman who was submitted to right total pneumonectomy for a discrete tumor of the right upper lobe. A subtotal hysterectomy and bilateral salpingo-oöphorectomy had been performed thirteen years previously for vaginal bleeding and a gross diagnosis of uterine carcinoma had been made. Recent cough and blood-tinged sputum caused the patient to seek medical help. She recovered from the operative procedure. The removed lung showed a solitary metastasis of uterine adenocarcinoma. On examination five months later the patient was in good general condition, with no evidence of recurrence.

King and Castleman[33] made an autopsy study of bronchial involvement in metastastic pulmonary malignancy. They report as follows:

> Necropsies performed at the Massachusetts General Hospital over a ten-year period on patients with metastatic pulmonary neoplasm were investigated in order to discover the incidence of those in whom actual invasion of the bronchus occurred. In 109 cases of pulmonary metastatic tumor 18.3 per cent showed bronchial invasion. In addition to these, 3 patients with malignant lymphoma showed bronchial invasion. It is believed that the incidence would have been much higher if especial attention were paid to the gross examination of the complete bronchial tree and if more sections were taken for microscopic study. Detailed analysis was made in 20 cases in which infiltration of the bronchial tree was found and the following observations were made: The neoplasm in 14 was carcinoma; in 6, sarcoma. Four patients (20 per cent) raised blood-streaked sputum. Nine patients (40 per cent) had no pulmonary symptoms.
>
> *Conclusions.* Metastatic pulmonary neoplasm may simulate a primary tumor. In a patient suspected of having pulmonary neoplasm, the raising of blood-streaked sputum cannot be considered as pathognomonic of a *primary* tumor. But the raising of blood in a case of metastatic pulmonary neoplasm is rare. In the present study, it occurred in only 4 out of 109 cases.

Tuberculosis. After deploring the fact that many bronchoscopists are not primarily interested in bronchoscopy or diseases of the chest, Lloyd and Budetti[34] go on to discuss bronchoscopy in pulmonary tuberculosis. They believe that the lesion in the bronchus is the same as that in the lung, and that the healing of the intrabronchial ulcer is conditioned on the development of a negative sputum, in which event the patient shows progressive improvement in the bronchus parelleling that in the lung. In view of the underlying pathology, they say, it is difficult to see how either cauterization of ulcers or dilatation of strictures can be of much value. They are opposed to dilatation because they have never seen a permanent increase in lumen by this procedure and are afraid of possible recurrence of pain, hemoptysis and even tubercle bacilli.

Warcalde[35] made autopsy studies of 3 cases in which there was an association of pulmonary tuberculosis and primary cancer of the bronchus. These cases proved that tuberculosis and cancer of the lung may coexist, and the author is inclined to think that this association is more frequent than is generally believed. In 2 of his cases, cancer had developed in a bronchus that had been chronically damaged by material eliminated from an old tuberculous cavity. In the third case, there was malignant degeneration of an old tuberculous cavity that had been partially epithelialized. These cases, as well as others cited from the literature, prove that chronic tuberculosis may bring about changes in the tissues from which cancer may develop. Nevertheless, tuberculosis cannot be considered a precancerous disease, nor is it true, as Ewing claimed,

that chronic tuberculosis is the chief cause of cancer of the lung. Warcalde goes on to say that there is no doubt that cancer may bring about exacerbation of old tuberculous lesions of the lung. This, too, was seen in these cases. Paradoxically, tuberculous lesions may disappear in the course of cancer. In one of these cases tuberculous tissue had been destroyed by the advancing cancer, and he cites a case described by Frommel in which no tuberculous tissue was found in the lungs of a patient dead of bronchial cancer who during life had repeatedly shown tubercle bacilli in the sputum. The cancer had destroyed both normal and tuberculous tissue after having caused exacerbation of the tuberculosis.

Tuttle, O'Brien, Day and Phillips,[36] in a study of 92 patients with ulcerobronchial or healed bronchial stenosis, made the following observations:

> Thirty-two per cent of this group are dead. Thirty-three per cent are still classified as unstable.
>
> Sixty-nine patients had ulcerostenosis when first seen. The ulcerative lesion was treated with 30 per cent silver nitrate. Seventy per cent of the group healed while 30 per cent did not change or become worse.
>
> Pneumothorax as a method of controlling the parenchymal processes has been compared with thoracoplasty.
>
> Pneumothorax was adequate in only 12 of the 47 instances in which it was used. The incidence of empyema and unexpanded lungs is high (31.9 per cent and 46.7 per cent, respectively).
>
> Thoracoplasty has yielded results superior to pneumothorax.

During the past year several articles have appeared on lobectomy and pneumonectomy for tuberculosis. Churchill and Klopstock[37] report 6 cases of pulmonary tuberculosis, 3 of which provided orthodox indications for resection of the lesion by lobectomy. Three others presented the usual indications for thoracoplasty but lobectomy was performed by election. Healing per primam resulted in all cases. Lobectomy provides a more selective and immediate method of eradicating certain lesions of tuberculosis than does collapse therapy. It may be used subsequent to artificial pneumothorax, thereby restoring to that procedure the reputation of finesse that it should enjoy. A method of treatment that combines conservation of lung function with immediate conversion of the sputum and a shortening of the span of treatment cannot be dismissed until its scope has been more fully explored. All patients were subjected to bronchoscopy preoperatively to rule out ulceration in the trachea and sometimes in the bronchus.

(To be concluded)

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CASE RECORDS OF THE MASSACHUSETTS GENERAL HOSPITAL

Weekly Clinicopathological Exercises

FOUNDED BY RICHARD C. CABOT

TRACY B. MALLORY, M.D., *Editor**

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CASE 30211

PRESENTATION OF CASE

A fifty-one-year-old machinist entered the hospital because of shortness of breath and productive cough.

The patient was in excellent health until one month before admission, when he developed a heavy cold characterized by malaise and cough, the latter usually occurring after returning from work in the evening and being relieved by the raising of a plug of greenish sputum. He felt so poorly that he stayed out of work for three or four days, during which time there was no change in his symptoms. He then returned to work but was weak and short of breath. He collapsed and was taken home, where he rested for ten days. He was then admitted to a community hospital, where x-ray studies were done and about 1500 cc. of fluid was removed from his chest, with considerable relief. He was discharged at the end of eight days under the care of a roentgenologist, who gave him "high-frequency" x-ray treatment every other day for a few days, without relief. The treatment was stopped and he became progressively more dyspneic. There was no chest pain, hemoptysis or known weight loss. For two months before the onset of his illness he had been constipated and had noted a decrease in the caliber of his stools. The abdomen became more protuberant and he experienced occasional transient crampy pain in the abdomen. He had no nausea, vomiting, loss of appetite or clay-colored or tarry stools.

Physical examination showed a well-developed, well-nourished, dyspneic man. The neck was "swollen" on both sides. The heart was not remarkable. There was dullness over the entire left chest, with decreased breath sounds, bronchial breathing and absent tactile fremitus. The abdomen was distended, with a fluid wave and shifting dullness.

The blood pressure was 130 systolic, 80 diastolic. The temperature was 99°F., the pulse 100, and the respirations 25.

Examination of the blood showed a red-cell count of 3,200,000, with 90 per cent hemoglobin. The white-cell count was 11,500, with 92 per cent neutrophils, 6 per cent lymphocytes and 2 per cent monocytes. The urine was normal. A blood Hinton test was negative.

X-ray examination revealed a large amount of fluid in the left pleural cavity, which compressed the left lung and displaced the heart and mediastinum to the right (Fig. 1). There appeared to be widening of the superior portion of the mediastinum on the right. The right lung field was fairly clear, with some increase in the markings. A small amount of fluid was seen in the right costophrenic angle. A barium enema was unsatisfactory because of inadequate preparation, but no abnormality of the colon could be demonstrated. The liver was somewhat enlarged. Thoracentesis in the left seventh interspace yielded 2400 cc. of watery, red fluid with a specific gravity of 1.011. A culture was negative, and no tumor cells were seen in the sediment. Following this procedure the patient improved considerably but temporarily. A second thoracentesis two days later yielded 750 cc. of similar fluid, but the dyspnea increased and he died on the fourth hospital day.

DIFFERENTIAL DIAGNOSIS

DR. REED HARWOOD: I take it that this patient did not have a cold. There is no mention of sore throat or coryza. I also presume that the radiologist in the outside hospital was able to see something after the chest tap that gave him an idea concerning the diagnosis. Our x-ray films are not definite enough to justify a diagnosis.

It is not clear from the history when the swelling of the abdomen took place.

The description of the cervical swelling could mean anything or nothing. Did it mean masses, was this actual edema of the neck or was it simply due to distended jugular veins?

DR. FRANK WHEELOCK: The swelling was at the base of the neck in the midline, extending down to the shoulder. It was fairly firm, but not a mass; just a swollen neck.

DR. HARWOOD: Was the bronchial breathing heard throughout the whole chest or simply near the upper level of the fluid?

DR. WHEELOCK: It was above the level of the fluid.

DR. HARWOOD: There must have been absent breath sounds low on the left side.

This man died soon after admission and presumably never had a bowel movement after entrance to the hospital, but with a story of crampy abdominal pain and decrease in the caliber of the stools, a test for occult blood in the stool would have been important.

DR. BENJAMIN CASTLEMAN: Blood examination at the outside hospital showed a red-cell count of 4,100,000, with 80 per cent hemoglobin.

DR. HARWOOD: We might see the x-ray films at this point.

*On leave of absence

Dr. Laurence L. Robbins: As is fairly evident, there is a large amount of fluid in the left pleural cavity displacing the heart and mediastinum to the right. There is a small amount of fluid in the right pleural cavity. I cannot tell much about the left lung. These films are suspicious of some disease within the lung, but it is indefinite on account of the fluid. A fairly important observation is the appearance of the right side of the superior mediastinum, which is large and somewhat lobulated in outline. The right lung is probably clear. It has a peculiar appearance, which is probably due to compression from the displaced mediastinum.

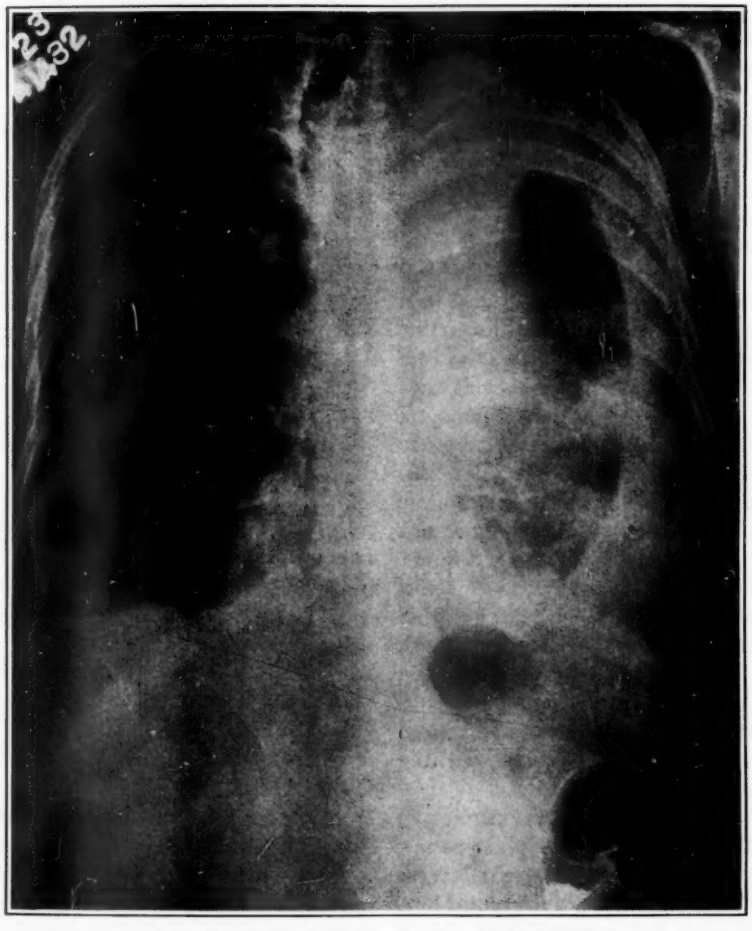

Figure 1. *Roentgenogram of Chest.*

On taking a quick look at the films of the barium enema, I do not believe there is much information to be obtained from them. The patient was not particularly well prepared.

Dr. Harwood: This shadow here is perhaps the mediastinal tumor.

Dr. Robbins: I do not believe that we have any way of knowing. Perhaps the patient was in a horizontal position for some time, and as the fluid accumulated in the posterior portion of the chest, the lung was pushed anteriorly. There is no evidence of the mass extending up into the neck. Everything has been pushed over to the right.

Dr. Harwood: Do you think the tumor alone has produced this angulation?

Dr. Robbins: I think that that is sufficient reason to explain it.

Dr. Harwood: The outstanding feature of this case is the rapidity with which the patient died. There is little in the way of symptoms on which to make a diagnosis until just a month before his death. I believe that he died of a malignant neoplastic disease, but I admit that I have little idea of what form of malignant disease it was.

It seems highly unlikely that this could have been an infection. With bloody pleural fluid and ascites, one might consider a generalized tuberculous infection. The patient, however, had no fever, and the disease was much too rapid in its downhill course.

The malignant diseases that we should consider are carcinoma, fibrosarcoma and some type of lymphoma. Before seeing the x-ray films, I did

not realize that the mediastinal lymph nodes were as enlarged as they seem to be on this x-ray film, and I considered carcinoma as the likeliest diagnosis. The question is, Where did it arise? We have one hint in the abdominal symptoms that he had. Did he have carcinoma of the colon? I am inclined to think not. I may be reasoning erroneously when I say that carcinoma of the colon is usually slowly growing, with metastases manifesting themselves late. I am going to rule it out.

Did he have carcinoma of the liver? The liver was enlarged, and that is the only single finding we have to implicate the liver. There were no abdominal masses and no jaundice. I am going to exclude the liver as the possible site of the tumor.

Did he have carcinoma of the stomach? The outstanding complaint might have been due to carcinoma high in the fundus. Carcinoma of the fundus occasionally goes unsuspected until metastases occur. He could easily have had metastases both to the peritoneum and to the lung and pleura.

Carcinoma of the lung must be considered, of course. He could have had a small carcinoma in a silent area of the lung, arising from a small bronchus so that, while the tumor grew, it did not invade a large bronchus to produce cough, hemoptysis and wheezing; then, as it approached the pleura, it might have produced pleural effusion and also metastases, both to the mediastinal lymph nodes and to the peritoneum. That is unusual, but I have an idea that this case is unusual, which is why it was presented.

Another possibility is that he had lymphoma — a generalized lymphomatous disease — with the most obvious manifestations in the mediastinal lymph nodes. The first real symptom might have been the cough, which suggests that the mediastinal tumor was pressing on the left main bronchus and that the mediastinal tumor grew to considerable size before producing definite symptoms.

I am at a loss to decide which of these attractive possibilities to choose, but I am going to place as my first bet lymphosarcoma of the mediastinal lymph nodes, pleura and peritoneum, and as the second bet, carcinoma of the lung, with metastases to the pleura and peritoneum. There is one possibility that I might mention, although I have no great confidence in it. With the mediastinum so involved, the inferior as well as the superior vena cava might have been pressed on by the tumor, producing, as it could easily, enlargement of the liver and ascites. Against that possibility is the fact that he had no peripheral edema.

Dr. Joseph C. Aub: Could the patient have died from replacement of the mediastinum to the left following the removal of the fluid? What does the mediastinal syndrome come from?

Dr. Robbins: I think that it is due to pressure of the tumor rather than to that of the fluid itself. I do not recall having seen an upper mediastinal syndrome produced by fluid.

Dr. Aub: I mean that death occurred because of replacement of the mediastinum to normal after the removal of the fluid. Why does it happen? It does.

Dr. Jacob Lerman: Death under those circumstances would be extremely rapid. This man lived for practically two days.

Dr. Castleman: One interesting point is that, while the patient was in the hospital, the left arm became swollen quite suddenly and markedly. Dr. Harwood, have you any further impression?

Dr. Harwood: The fact does not seem to have any diagnostic importance. We know that he had enlarged mediastinal lymph nodes. Swelling of either arm, the face or the neck can occur at any time with an expanding mediastinal lesion.

Clinical Diagnosis

Mediastinal tumor, with extension to lung.

Dr. Harwood's Diagnosis

Lymphosarcoma of mediastinal lymph nodes, pleura and peritoneum, with metastases?

Bronchiogenic carcinoma, with metastases to mediastinal lymph nodes, pleura and peritoneum?

Anatomical Diagnoses

Oat-cell carcinoma of left lung, with extension to trachea, pleura and pericardium, with compression and thrombosis of left subclavian vein and with metastases to the vertebras.

Hemothorax, bilateral.

Pulmonary atelectasis, left.

Bronchopneumonia, right lower lobe.

Peripheral edema of arms.

Pathological Discussion

Dr. Castleman: The autopsy on this man showed a large nodular mediastinal mass, which was believed to be involved lymph nodes. The mass extended upward about 3 cm. into the suprasternal notch, inferiorly to cover the upper third of the external surface of the pericardium and then to the left to involve the pleura of the left lung all along the hilus. When we cut across the mass we could see that it surrounded the aorta, the left subclavian vein and the right side of the superior vena cava. All the structures in that region were compressed but apparently not infiltrated by the tumor. The left subclavian vein was thrombosed. Because the superior vena cava was merely compressed rather than infiltrated, we thought that the best diagnosis was some form of malignant lymphoma, since carcinoma is usually infiltrative.

On opening the trachea and bronchi we found that there was extensive involvement of the left main bronchus with tumor, but the lumen was still patent. The mediastinal nodes surrounding the trachea

had penetrated the trachea in one place to form an intrinsic mucosal plaque of tumor 1 cm. long and 3 mm. wide. It is interesting that in so doing the tumor, as is usual, surrounded the cartilaginous plates but had not destroyed them. The tumor had extended into the lung parenchyma.

On microscopic examination the tumor proved to be an oat-cell carcinoma of the lung. The only other metastases found, in addition to the mediastinal lymph nodes, were in the vertebras, which were almost completely replaced by tumor, and one certainly should have expected severe myelophthisic anemia.

DR. HELEN PITTMAN: Did he have ascites?

DR. CASTLEMAN: No.

CASE 30212

PRESENTATION OF CASE

A sixty-six-year-old housewife entered the hospital because of severe pain in the right leg.

The patient was known to have been hypertensive for many years. For several months before entry she had "palpitation" and had been given 3 gr. of quinidine four times daily. She had been in fairly good health for the preceding two or three weeks and was able to carry on with the usual housework. Early one evening, about twenty-two hours before admission, she was suddenly seized with an intense, substernal pain in the chest, which radiated to the right midback and was aggravated by inspiration. She felt that she could not breathe. The pain was followed almost immediately by intense pain in the right leg, extending from the hip to the foot. The leg felt completely numb and she could not move it. She was seen by her physician who found her in shock — cold and clammy. The pulse was 120 and regular. The blood pressure, which had been around 250 systolic, 190 diastolic, was 200 systolic, 110 diastolic. There was no fever. After the onset of pain in the leg, the pain in the chest practically disappeared and she was able to breathe without difficulty. This, however, may have been due to the fact that the former was so severe that the latter was ignored. She was given ½ gr. of morphine through the night and the next morning, without relief. She perspired considerably, but voided little urine. She had had "virus pneumonia" three or four months prior to admission, followed by a chronic productive cough and by general sinus infection.

Physical examination showed a well-developed, well-nourished, sallow patient who appeared to be critically ill and complained bitterly of pain in the right leg. The leg was swollen, cold, "anesthetic and paretic," with mild grayish cyanosis involving the entire extremity; no arterial pulsation could be felt. She could not wiggle her toes. The heart was enlarged, the left border of cardiac dullness being 10 cm. to the left of the midline in the fifth space. The sounds were regular. A rough, distant, systolic murmur, loudest at the apex, was heard by one observer. Examination of the lungs was unsatisfactory. The abdomen was negative.

The blood pressure was 110 systolic, 60 diastolic, in the right arm, and 115 systolic, 60 diastolic, in the left. The pulse was 92. The temperature and respirations were normal.

The patient was given ¼ gr. of morphine every three hours and ½ gr. of papaverine every four hours. A lumbar paravertebral novocain injection was performed in the right first, second and third lumbar regions without any objective or subjective change in the leg. About ten hours after admission rectal bleeding was noted. The pulse rose to 110, the respirations were 30, and the blood pressure fell rapidly. There was some bloody sputum, and the patient died a few minutes later.

DIFFERENTIAL DIAGNOSIS

DR. WYMAN RICHARDSON: The story as we are given it here seems to me definite and quite pathognomonic. I know of no condition that produces intense chest pain followed shortly by terrific pain in the leg other than a dissecting aortic aneurysm, and that seems to me the only possible diagnosis in this case.

The heart examination is not particularly specific although there may have been varying murmurs; at least the suggestion here is that the murmur was heard by only one observer and was loud. Physical examination corroborates the diagnosis of dissecting aortic aneurysm.

In regard to other possible diagnoses, I am so sure about this that it looks as if I might be riding to a fall; although I do not see how the diagnosis can be anything else. If one has to make another diagnosis, one must contemplate something that will produce intense chest pain and obstruction to the right iliac artery or some large artery of the leg. If one is considering the possibility of a venous embolus, there might be intense chest pain with a pulmonary embolus. I suppose it is conceivable that one could have a paradoxical embolus to the right iliac artery, but it would have to be a big patent foramen ovale to allow the embolus to get through; and that seems hardly worth considering. The only other thing I can think of is a silent coronary occlusion with a myocardial infarct, followed by a mural thrombus; then a second myocardial infarct, this one not silent, producing severe pain in the chest and at the same time dislodging the previous thrombus and sending it to the iliac artery. This also seems to be an almost impossible coincident. Otherwise I cannot think of any condition that would produce intense pain in the chest and would occlude the right iliac artery.

Regarding the laboratory findings, I am interested for my own benefit to know — possibly Dr. Castleman does not have this knowledge — whether there

was increased leukocytosis. One would expect that with a dissecting aneurysm, where blood is being disseminated through tissues not used to having a lot of free blood in them, there would be considerable leukocytosis.

DR. BENJAMIN CASTLEMAN: No blood count is recorded.

DR. RICHARDSON: I thought that might be the case.

The other thing I want to speak of is the matter of therapy. Evidently the hope was that a good deal of the difficulty with circulation in the leg was due to secondary spasm; hence, efforts were made to relieve the secondary spasm of the artery. I do not believe that the method employed would have been particularly successful. There is one procedure I can think of — and it has been attempted[1] — that might relieve the whole situation, namely, to open the iliac artery and also to make an opening in the dissecting aneurysm, so that the pressure from the arterial system is relieved, as sometimes happens spontaneously. This may produce a remission, often of considerable duration. We had a case on the ward some years ago in which I took great pride in making a diagnosis of dissecting aneurysm. The patient got well, and subsequently this diagnosis was discarded. I am taking this opportunity to brag about the fact that this patient, who died several years later, did have a dissecting aneurysm that had evidently dissected some years before. In the present case, as I said before, I cannot see how the diagnosis can be anything other than dissecting aortic aneurysm.

There remains one thing to discuss — the manner of the patient's death. As you probably all know, these patients often die of cardiac tamponade, owing to the leakage of blood into the pericardial sac or around the coronary arteries, with pressure on the coronary arteries and a final rupture into the pericardial sac with cardiac tamponade. That seems the likely reason for this patient's death. It ought to be mentioned that such patients sometimes develop anuria due to pressure around the renal arteries, with renal ischemia. Hematuria is not an uncommon finding in these cases.

The pathological findings also might be discussed. There is usually a cystic necrosis of the aorta. I believe that this condition may arise from a purely atheromatous lesion, and there may be reason to doubt whether this patient actually did have cystic disease of the aorta. If, however, one is to bet on chance it is much better to say that there was cystic degeneration of the aorta. I cannot think of any incidental findings that may be found. One might say that in patients of this age it probably is a better procedure to try to think of all the various pathologic lesions that there might have been, because one often finds a great many different lesions occurring in such patients, and I am rather inclined to disagree with Dr. Cabot's dictum, namely, that one should make one diagnosis fit all the symptoms. In this case, with the symptoms given, I can think of but one diagnosis that fits all the symptoms and that is dissecting aortic aneurysm.

DR. CASTLEMAN: Does anyone want to quiz Dr. Richardson?

A PHYSICIAN: How does he explain the bloody stools?

DR. RICHARDSON: I meant to mention the bloody stools. I do not explain them on the basis of aortic aneurysm. It seems conceivable that there might have been sufficient interference with the arterial supply to the lower rectum, in the same manner that there was interference to the supply of the blood to the leg, so that there was an ischemia or infarct involving the lower bowel.

DR. CHESTER M. JONES: Could you not have interference with the inferior mesenteric vessels, with probably an infarct in the region that they supply?

DR. RICHARDSON: Yes; I thought that might explain it. I do not know why, but I have a hunch that the pathologist will not be able to explain the bloody stools.

CLINICAL DIAGNOSIS

Dissecting aneurysm?

DR. RICHARDSON'S DIAGNOSIS

Dissecting aortic aneurysm.

ANATOMICAL DIAGNOSES

Dissecting aneurysm of aorta, with involvement of the major branches and occlusion of the right common iliac artery.
Pulmonary hemorrhage, bilateral.
Hemothorax, bilateral.
Hemopericardium.
Hemoperitoneum, slight.
Cardiac hypertrophy, hypertensive type.
Early infarction of intestine?
Arteriosclerosis, generalized.

PATHOLOGICAL DISCUSSION

DR. CASTLEMAN: The autopsy on this patient showed what Dr. Richardson predicted. This patient did have an aortic dissection. The physician in charge of this case reasoned the same way, but he was not so sure of his diagnosis. In the first place the hypertension did not remain up, as it does in the majority of cases. In this case the blood pressure had fallen.

DR. RICHARDSON: The blood pressure does not fall in the majority of cases?

DR. CASTLEMAN: In most of the cases that we have had here, the blood pressure has remained elevated.

DR. C. SIDNEY BURWELL: That is true. It is one of the differential points between coronary thrombosis and aortic dissection.

DR. CASTLEMAN: In about 80 per cent of our cases the pressure remained elevated,[2] and the man in charge of this patient thought that that was one point against dissecting aortic aneurysm. He also thought that the patient should have continued to have at least some pain in the chest, which apparently she did not have after the initial attack.

At autopsy the heart was slightly enlarged and of the hypertensive type. In the arch was the intimal tear, a horizontal one that involved one third of the circumference of the aorta. There was only a slight to moderate amount of arteriosclerosis, but the intimal tear did not arise on an atheromatous plaque — in fact it very rarely, if ever, does. The tear went through the intima and two thirds of the way through the media, dissecting proximally to the annulus of the aortic valve and distally down the whole length of the abdominal aorta, first into the carotid and innominate arteries and then into both renal arteries (Fig. 1). The dissection around the mouths of both renal arteries accounted for the anuria. It extended into the right iliac artery, elevating the intima and producing a complete occlusion. It also dissected into the openings of the celiac axis and the inferior and superior mesenteric vessels. The small bowel was completely filled with blood and showed early gangrene.

The external perforation of the aneurysm was not too clear. We found only 250 cc. of blood in the pericardial cavity, much less than one sees with rupture of the adventitia that produces cardiac tamponade, which was not present. There was also about 200 cc. of blood in each pleural cavity, but here again there was no definite external rupture of the adventitia. Blood was present in the adventitia of the main pulmonary arteries and extended into the lungs so that we found hemorrhage into both lungs, a condition that we have seen twice before. I suppose the patient really died because of the slow oozing of blood throughout all parts of the aorta.

Microscopic examination of the aorta showed medial degeneration.

DR. RICHARDSON: Were the coronary arteries dissected?

DR. CASTLEMAN: No.

DR. RICHARDSON: Do you suppose that the extensive involvement of the leg could have accounted for the drop in blood pressure?

DR. BURWELL: The amount of blood that the patient had lost might have accounted for it.

DR. CASTLEMAN: This case would probably have not been a good one on which to try the iliac-artery operation that Dr. Richardson mentioned. The patient was much too sick.

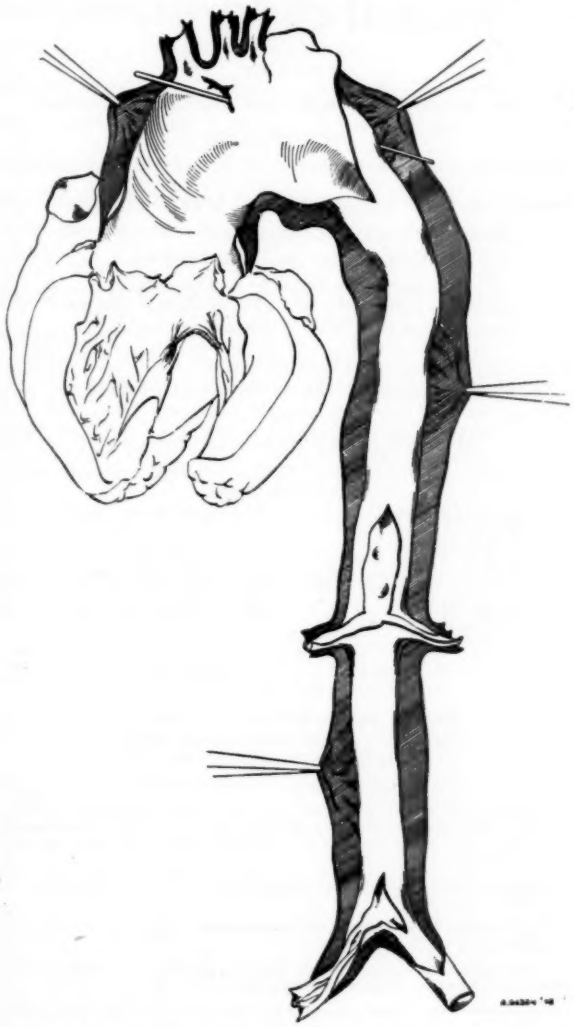

FIGURE 1. *Drawing Showing the Extent of the Dissecting Aneurysm.*

DR. BURWELL: Has that really been done?

DR. CASTLEMAN: Not here, but it has been tried in New York City, as I have already mentioned. The patient died six days after operation.

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1. Gurin, D., Bulmer, J. W., and Derby, R. Dissecting aneurysm of aorta; diagnosis and operative relief of acute arterial obstruction due to this cause. *New York State J. Med.* **35**:1200-1202, 1935.
2. Glendy, R. E., Castleman, B., and White, P. D. Dissecting aneurysm of aorta. *Am. Heart J.* **13**:129-162, 1937.

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PENICILLIN

THANKS to the initiative and enterprise of certain pharmaceutical houses and other industrial plants, supplies of penicillin have increased to such a point that the drug is about to be released for more extensive civilian use than has been possible during the past year. Up to this time only a limited quantity has been available for emergency civilian use on allocation by the War Production Board through a committee of the National Research Council. Although greater amounts are now on hand, allocation is to be continued by the War Production Board, aided by an advisory panel representing the National Research Council, the United States Public Health Service and the American Medical Association.

To aid in the proper storage and distribution of penicillin, a list of "depot hospitals" has been prepared by the Office of Civilian Penicillin Distribution of the War Production Board, those selected for New England being designated elsewhere in this issue of the *Journal*. Each hospital will be permitted to purchase a monthly quota, and other hospitals in its vicinity will be allowed to obtain their supplies through this depot.

The responsibility for the intelligent civilian use of this new drug now rests in the hands of practitioners, and they should not fail to realize that the supply is still limited. Penicillin has been proved capable of remarkable therapeutic results; on the other hand, its indiscriminate use in all types of infection will result in a shortage for the treatment of the very type of case in which a cure may be expected.

PHYSICAL MEDICINE

THE gift of $1,100,000 by Bernard M. Baruch to sponsor the development of teaching and research in physical medicine comes at a particularly opportune time. In the physical rehabilitation of wounded and ill soldiers and sailors and victims of industrial accidents, as well as of the young and old suffering from disabilities of locomotion, physical and occupational therapy is destined to play an important role. Mr. Baruch's interest in physical therapy arose because of his father Dr. Simon Baruch, a prominent hydrologist and a pioneer in this field, and was further stimulated by a desire to aid disabled war veterans. His decision to benefit physical medicine, however, was dependent on the results of a thorough scientific exploration of the subject. To accomplish this a committee under the chairmanship of Dr. Ray Lyman Wilbur and directed by Dr. Frank H. Krusen was formed. Nine subcommittees were also appointed, including those dealing with the subjects of poliomyelitis, occupational therapy, prevention and body mechanics, hydrology and health resorts, clinical and basic research, rehabilitation and teaching. Over four hundred scientists were consulted in the course of a comprehensive three-month survey. The final report, seeking to emulate those famous reports of Mr. Baruch for which he

became known as "Mr. Facts," is a valuable source of information on the multiple aspects of physical medicine.

This report emphasizes the wide scope of physical medicine and its possible application in nearly all fields of medical practice. Physical agents produce striking biologic responses and psychic reactions, which in potency compare favorably with those of drugs and other established therapeutic procedures. In order that these agents may be widely recognized and used the primary step in development is considered the education of teachers and specialists in physical medicine. This is to be accomplished by establishing key centers in selected medical schools where, through basic and clinical research, a background of scientific knowledge will be accumulated. Teachers will be trained in these centers who, in turn, will go to the medical schools of the country to educate future physicians in what are considered to be the important essentials of physical therapy. A supply of specialists will also become available to aid in postwar physical rehabilitation. The center at the College of Physicians and Surgeons, Columbia University, will serve as the chief training center where all phases of physical medicine will be developed and co-ordinated, including electronics, hydrology, climatology, manipulative procedures and occupational therapy. Hydrology and spa therapy will be the major concern of another center, and at the third, the structural mechanics of the body will be studied. An important aspect of this will be a careful scientific analysis of nonmedical, therapeutic procedures and claims by practitioners of osteopathy, chiropractic and naturopathy.

Extensive fundamental studies must be made, and results cannot be expected at once. Scientific data are accumulated only slowly and painstakingly. The wisdom of setting up these centers on a ten-year basis is thus apparent. It is reasonable to expect, however, that proper recognition and an increased use of physical medicine will be achieved in a fairly short time. The full benefits of this million-dollar gift will not be apparent until physical medicine is firmly established on a scientific basis by this preliminary period of research. The future practice of medicine will then be influenced by the widespread instruction of medical students in the procedures of physical therapy that have proved to be worth while. Provided that the work at the key centers is successfully carried out with the active co-operation of the medical faculties and that the anticipated results are obtained, still greater projects, already outlined in the original report of the committee, have been promised similar financial aid. One envisions an important step in the progress of medicine accelerated by Mr. Baruch's percipient philanthropy.

MASSACHUSETTS MEDICAL SOCIETY

DEATH

WENTWORTH — Mark H. Wentworth, M.D., of Concord, died May 15. He was in his sixty-sixth year.

Dr. Wentworth received his degree from Harvard Medical School in 1905. He was a member of the Massachusetts Medical Society, the American Medical Association, the Boston Surgical Society and the New England Pediatric Society.

His widow, two daughters and two grandchildren survive.

MASSACHUSETTS DEPARTMENT OF PUBLIC HEALTH

COMMUNICABLE DISEASES IN MASSACHUSETTS FOR MARCH, 1944

Résumé

Diseases	March 1944	March 1943	Seven-Year Median
Anterior poliomyelitis	0	2	0
Chancroid	2	**	**
Chicken pox	3364	1604	1471
Diphtheria	25	9	12
Dog bite	739	706	754
Dysentery, bacillary	19	4	3
German measles	313	8210	105
Gonorrhea	509	327	327
Lymphogranuloma venereum	5	**	**
Measles	3546	6416	3245
Meningitis, meningococcal	68	118	10
Meningitis, Pfeiffer-bacillus	4	3	2
Meningitis, pneumococcal	7	2	*
Meningitis, staphylococcal	0	0	*
Meningitis, streptococcal	2	2	*
Meningitis, other forms	1	4	*
Meningitis, undetermined	17	12	*
Mumps	1576	1077	1077
Pneumonia, lobar	423	372	609
Salmonella infections	13	2	2
Scarlet fever	1915	2494	1184
Syphilis	674	479	479
Tuberculosis, pulmonary	267	283	286
Tuberculosis, other forms	22	18	27
Typhoid fever	3	0	3
Undulant fever	3	1	3
Whooping cough	378	874	969

*Pfeiffer-bacillus meningitis only other form reportable previous to 1941.
**Made reportable December, 1943.

Comment

Diphtheria remained relatively high, — twice the seven-year median, — although the disease was below the level of the last two months of 1943.

Meningococcal meningitis was at a point almost seven times the seven-year median but was much below the level of March of last year. Nevertheless, the total number of cases for the first three months of this year exceeded that for the corresponding period of last year.

The thirteen cases of salmonella infections represent a new high for March. They were not widely distributed, however, seven of them occurring in one city.

Geographical Distribution of Certain Diseases

Actinomycosis was reported from: Palmer, 1; total, 1.

Diphtheria was reported from: Boston, 5; Cambridge, 1; Lawrence, 15; Lowell, 1; Mattapoisett, 1; Methuen, 1; Salem, 1; total, 25.

Dysentery, amebic, was reported from: Fort Devens, 1; total, 1.

Dysentery, bacillary, was reported from: Boston, 2; Worcester (State Hospital), 17; total, 19.

Encephalitis, infectious, was reported from: Braintree, 1; total, 1.

Lymphocytic choriomeningitis was reported from: Springfield, 1; total, 1.

Malaria was reported from: Boston, 1; Camp Edwards, 14; Cushing General Hospital, 7; Fall River, 1; Fort Banks, 11; Fort Devens, 20; Haverhill, 4; Millbury, 1; Milton, 1; Newburyport, 1; Plymouth, 1; U. S. Marine Hospital (Boston), 1; total, 63.

Meningitis, meningococcal, was reported from: Agawam, 1; Arlington, 2; Ashland, 1; Attleboro, 1; Ayer, 1; Boston, 19; Braintree, 2; Brockton, 2; Camp Edwards, 2; Cambridge, 2; Chelsea, 1; Chicopee, 1; Everett, 1; Fall River, 3; Fort Devens, 2; Franklin, 1; Lexington, 1; Lowell, 2; Malden, 1; Marblehead, 1; Middleboro, 1; Milford, 1; Milton, 3; Newton, 2; Norton, 1; Pittsfield, 1; Quincy, 1; Saugus, Jamesbury, 1; Somerville, 1; Sturbridge, 1; Waltham, 1; Watertown, 2; Westfield, 2; West Springfield, 1; Worcester, 1; total, 68.

Meningitis, Pfeiffer-bacillus, was reported from: Brockton, 1; New Bedford, 1; Weymouth, 2; total, 4.

Meningitis, pneumococcal, was reported from: Boston, 2; Cambridge, 1; Cohasset, 1; Norwood, 1; Salem, 1; Worcester, 1; total, 7.

Meningitis, streptococcal, was reported from: Lawrence, 1; New Bedford, 1; total, 2.

Meningitis, other forms, was reported from: Boston, 1; total, 1.

Meningitis, undetermined, was reported from: Boston, 3; Cambridge, 2; Chelsea, 1; Holyoke, 1; Quincy, 5; Westfield, 2; Worcester, 3; total, 17.

Salmonella infections were reported from: Attleboro, 1; Bedford, 1; Dartmouth, 1; Lynn, 1; Manchester, 1; Medford, 1; Newton, 7; total, 13.

Septic sore throat was reported from: Amesbury, 1; Bedford, 1; Boston, 9; Bourne, 1; Cambridge, 1; Camp Edwards, 4; Haverhill, 2; Lawrence, 3; Merrimac, 8; Newbury, 1; Newton, 2; Scituate, 1; Winchester, 1; Worcester, 2; total, 37.

Tetanus was reported from: New Bedford, 1; Quincy, 1; total, 2.

Trichinosis was reported from: Boston, 3; Chelsea, 3; total, 6.

Typhoid fever was reported from: Fall River, 1; New Bedford, 1; North Attleboro, 1; total, 3.

Undulant fever was reported from: Boston, 1; Cambridge, 1; Winchester, 1; total, 3.

MISCELLANY

DEPOT HOSPITALS FOR PENICILLIN

The following New England institutions have been selected to serve as "depot hospitals" by the Office of Civilian Penicillin Distribution, War Production Board, for the proper storage and distribution of penicillin for civilian medical use. These hospitals will be the local depots for further distribution of the drug, as well as a source of supply for their own requirements. They will recognize the request of other hospitals and, if the need is established, will, to the best of their ability in consideration of their supply on hand, furnish penicillin for purchase by such other hospitals. This list is subject to revision by action of the Advisory Panel.

CONNECTICUT

Bridgeport.
Bridgeport Hospital
St. Vincent's Hospital

Bristol.
Bristol Hospital

Danbury.
Danbury Hospital

Hartford.
Hartford Hospital
Municipal Hospitals
St. Francis Hospital

Meriden.
Meriden Hospital

Middletown.
Middlesex Hospital

New Britain.
New Britain General Hospital

New Haven.
Grace Hospital
Hospital of St. Raphael
New Haven Hospital

New London.
Lawrence and Memorial Associated Hospital

Norwalk.
Norwalk General Hospital

Norwich.
William W. Backus Hospital

Torrington.
Charlotte Hungerford Hospital

Waterbury.
St. Mary's Hospital
Waterbury Hospital

MAINE

Augusta.
Augusta General Hospital

Bangor.
Eastern Maine General Hospital

Dover-Foxcroft.
Mayo Memorial Hospital

Lewiston.
Central Maine General Hospital
St. Mary's General Hospital

Portland.
Maine General Hospital
Mercy Hospital

Presque Isle.
Presque Isle General Hospital

Rockland.
Knox County General Hospital

Rumford.
Rumford Community Hospital

MASSACHUSETTS

Beverly.
Beverly Hospital

Boston.
Beth Israel Hospital
Boston City Hospital
Carney Hospital
Children's Hospital
Faulkner Hospital
Massachusetts General Hospital
Massachusetts Memorial Hospitals
New England Deaconess Hospital
New England Hospital for Women and Children
Peter Bent Brigham Hospital
St. Elizabeth's Hospital

Brockton.
Brockton Hospital

Cambridge.
Cambridge City Hospital
Cambridge Hospital

Chelsea.
Chelsea Memorial Hospital

Fall River.
Truesdale Hospital
Union Hospital

Fitchburg.
Burbank Hospital

Framingham.
Framingham Union Hospital

Greenfield.
Franklin County Public Hospital

Lawrence.
Lawrence General Hospital

Lowell.
Lowell General Hospital
St. John's Hospital
St. Joseph's Hospital

Lynn.
Lynn Hospital

New Bedford.
St. Luke's Hospital

Northampton.
Cooley Dickinson Hospital

Pittsfield.
House of Mercy Hospital
St. Luke's Hospital

Quincy.
Quincy City Hospital

Salem.
Salem Hospital

Springfield.
Mercy Hospital
Springfield Hospital
Wesson Memorial Hospital

Worcester.
Memorial Hospital
St. Vincent Hospital
Worcester City Hospital
Worcester Hahnemann Hospital

NEW HAMPSHIRE

Berlin.
St. Louis Hospital

Concord.
Margaret Pillsbury General Hospital

Hanover.
Mary Hitchcock Memorial Hospital

Keene.
Elliot Community Hospital

Manchester.
Elliot Hospital
Sacred Heart Hospital

Nashua.
Nashua Memorial Hospital

Portsmouth.
Portsmouth Hospital

RHODE ISLAND

Newport.
Newport Hospital

Pawtucket.
Memorial Hospital

Providence.
Homeopathic Hospital
Rhode Island Hospital
St. Joseph's Hospital

Westerly
Westerly Hospital

VERMONT

Bennington.
Henry W. Putnam Memorial Hospital

Burlington.
Bishop De Goesbriand Hospital
Mary Fletcher Hospital

Montpelier.
Heaton Hospital

Newport.
Orleans County Memorial Hospital

Rutland.
Rutland Hospital

St. Albans.
St. Albans Hospital

St. Johnsbury.
Brightlook Hospital

NOTICES

PHI DELTA EPSILON LECTURE

Dr. Edward Weiss, professor of medicine at Temple University School of Medicine, will deliver the first annual Phi Delta Epsilon lecture at Boston University School of Medicine auditorium, on Wednesday, May 31, at 8:15 p.m. His topic will be "Psychosomatic Aspects of Cardiovascular Diseases." He will be introduced by Dr. Chester S. Keefer.

NEW ENGLAND HOSPITAL FOR WOMEN AND CHILDREN

The monthly clinical conference and meeting of the staff of the New England Hospital for Women and Children will be held on Thursday, June 1, at 7:15 p.m. in the classroom in the nurses' residence. Dr. Samuel R. Meaker will speak on the subject, "Sterility." Dr. Ilia Galleani will be chairman.

(*Continued on page xv*)

NOTICES (*Continued from page 656*)

SOCIETY MEETINGS AND CONFERENCES

CALENDAR OF BOSTON DISTRICT FOR THE WEEK BEGINNING THURSDAY, JUNE 1

THURSDAY, June 1
7:15 p.m. Sterility. Dr. Samuel R. Meaker. New England Hospital for Women and Children.

SATURDAY, JUNE 3
*10:00-11:30 a.m. Medical staff rounds. Peter Bent Brigham Hospital.

MONDAY, JUNE 5
*12:15-1:15 p.m. Clinicopathological conference. Peter Bent Brigham Hospital.

TUESDAY, JUNE 6
*12:15-1:15 p.m. Clinicoroentgenological conference. Peter Bent Brigham Hospital.

WEDNESDAY, JUNE 7
*12:00 m. Clinicopathological conference. Children's Hospital.

*Open to the medical profession.

MAY 26. New England Heart Association. Page xii, issue of May 11.

MAY 31. Phi Delta Epsilon Lecture. Page 656.

JUNE 7-13. American Board of Obstetrics and Gynecology. Page x, issue of March 23.

JUNE 8-10. American Board of Internal Medicine. Page x, issue of April 20.

JUNE 12-16. American Medical Association. Page 798, issue of November 18.

JUNE 12-16. American Physicians' Art Association. Page x, issue of March 2.

JUNE 14. Harvard Medical Alumni Association. University Club, Chicago.

JUNE 14. Tufts Medical Alumni Dinner. Chicago.

OCTOBER 3-5. American Public Health Association. Page ix, issue of March 30.

TUFTS MEDICAL SCHOOL

Postgraduate Courses for the General Practitioner

HEMATOLOGY C. July 3–15. An intensive course, offering instruction in hematology through lectures, informal discussions, and laboratory bedside teaching. Topics included will be blood-forming organs with particular reference to bone-marrow biopsy, blood cells, the various hematological technics, anemia, polycythemia, leukopenia, leukemia, tumors of the blood-forming organs, and the hemorrhagic diseases. Course given by Dr. William Dameshek. Tuition fee, $75.

OTOLARYNGOLOGY. A morning (9:30–12) course given monthly for the general practitioner under the full-time personal supervision of Dr. George Kelemen, surgeon-in-charge, Ear, Nose and Throat Clinic, Boston Dispensary. Anatomical demonstrations, clinical work and discussions. Tuition fee, per month: five mornings a week, $50; three mornings a week, $30.

OPHTHALMOLOGY. A course given monthly three mornings a week at the Boston City Hospital by Dr. Joseph Igersheimer. The commoner external eye diseases and their treatment are taught through demonstration of patients, with instruction in the proper use of the ophthalmoscope and interpretation of the normal fundus and fundus lesions in relation to general medicine. Tuition fee, $50.

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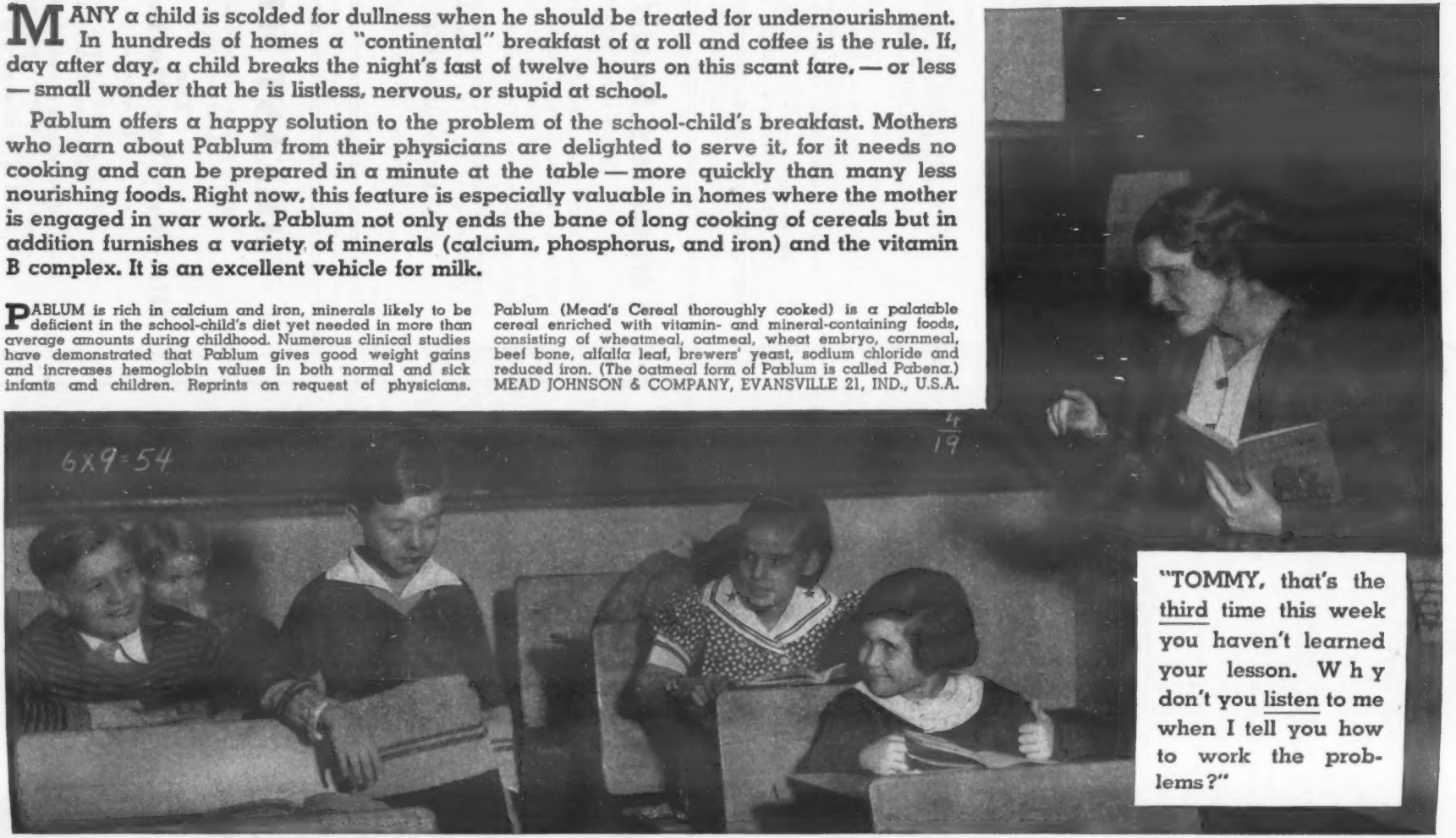
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4/19
"TOMMY, that's the third time this week you haven't learned your lesson. W h y don't you listen to me when I tell you how to work the problems?"